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THE
RAW MATERIALS OF INDUSTRY

COTTON and WOOL

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By

J. S. M. WARD, B.A., F.S.S., F.R.Econ.S.

Fellow of the Royal Colonial Institute
Late Scholar and Prizeman of Trinity Hall, Cambridge
Head of the Intelligence Dept., the Federation of
British Industries

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With an Introduction by

Sir HERBERT DIXON

President of the International Cotton Federation

LONDON
WILLIAM RIDER & SON, LTD.
8 PATERNOSTER ROW, E.C.
1921

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INTRODUCTION

THE FINE COTTON SPINNERS' AND DOUBLERS' ASSOCIATION, LIMITED.

ST. JAMES'S SQUARE,
MANCHESTER,
July 19, 1920.

THOSE of us who realize the danger hanging over the Cotton Textile Industry, a danger which may have very far-reaching effects in the near future, will, I am sure, welcome most heartily this volume of Mr. Ward's, dealing as it does very simply, and yet very thoroughly, with the Cotton position as it stands to-day. For many seasons past the Cotton crops, especially from the all-important Southern States of America, have resulted in what can only be termed a partial failure despite large acreage and every inducement to the planter to produce as much as possible. Shortage of labour, lack of sufficient artificial fertilization, and various other causes are put forward by the growers year by year, but, to my mind, no amount of excuse can explain away the fact, that at a time when prices are temptingly high, when good crops mean a fortune to the planter, they still continue to grow less and less per acre as the years roll by. Whilst this unsatisfactory and alarming condition of things goes on we are confronted with a demand, especially in the United

States, which goes up, as shown in this book, by leaps and bounds. In a few years from now, in my opinion, we shall be face to face with a shortage of so serious a nature, that in the general scramble for Cotton, many will be left out in the cold, operatives will be thrown out of employment, and the present abnormally high prices of all cotton goods will not only continue but will very possibly go still higher. It is futile to hide one's head in the sand, and trust that all will be well in the end. It behoves us rather to be up and doing without delay. This book deals so completely with the whole question that any further words of mine would be superfluous, except perhaps to add how much I appreciate the way the author has handled the subject, and how sincerely I trust that the Cotton world will not only carefully read and digest the book but will be prepared afterwards to take part in any well-considered scheme to increase our supplies.

A. Herbert Dixon.

PREFACE

IN giving this little book to the world, I feel I must point out that its object is to place before every one interested in cotton and wool the true position with regard to these essential raw materials in a handy and convenient form, and in as simple language as possible. I cannot expect that such authorities as Dr. Todd and Dr. Ball in cotton and Mr. Omerod in wool will find much to interest them. On the contrary, to them and the authors of most of the books that appear in my bibliography I am largely indebted. I trust, however, that those who are employed in the business of cotton and wool will find much useful matter here.

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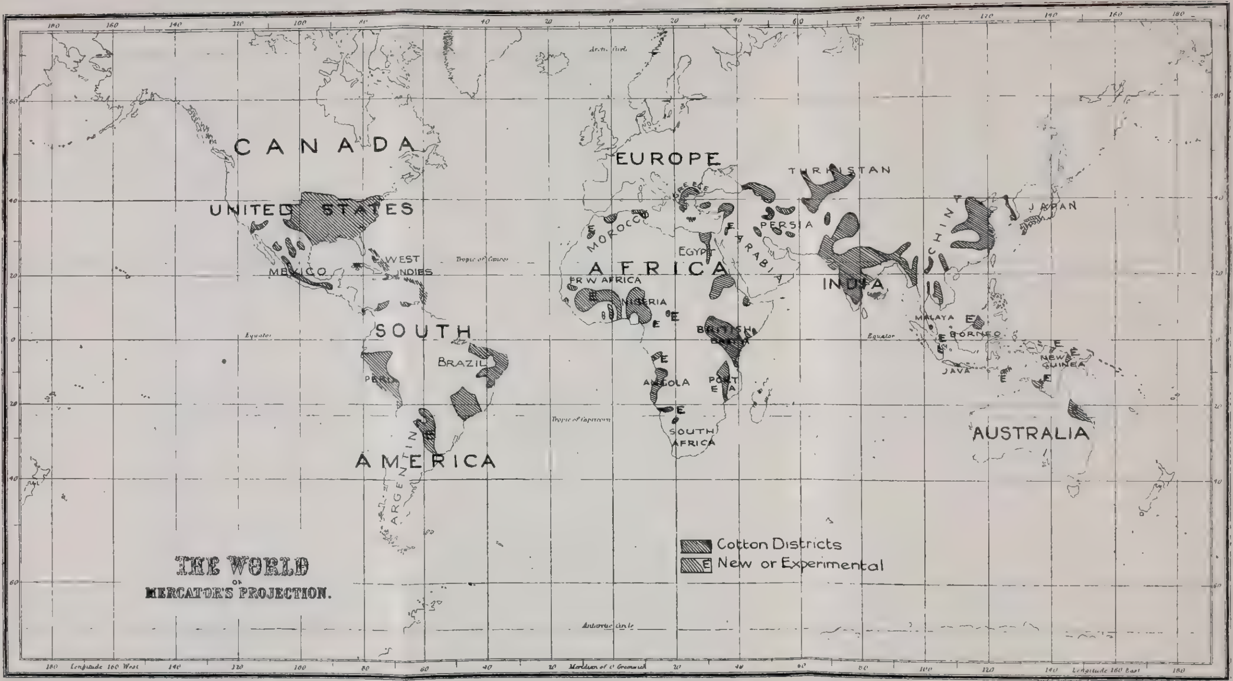
PART I

COTTON

THE COTTON-GROWING AREAS OF THE WORLD



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CHAPTER I

CLASSIFICATION OF COTTON

Definition

RAW cotton consists of long hairs which cover the seed of various species of *Gossypium*, which belong to the Mallow family. Each of these hairs consists of a single long narrow cell or tube without any transverse partitions.

Classification

Cotton may be classified by microscopic examination, by chemical examination and by measurement of its length and extensibility.

The first two are of scientific rather than economic interest, although it would be a mistake to imagine for one instant that the work of the scientist can be ignored by the industrialists. On the contrary, the more closely Science and Industry go hand in hand, the better for the well-being of Industry.

Nevertheless, for the purposes of a handbook like this, it is the third form of classification which is of most practical use. Those who wish to study the more strictly scientific side will find that such places as the Imperial Institute are the most suitable sources of information.

Strength and Elongation

One of the chief objects of chemical examination of any fibre is to ascertain the character and proportion of cellulose present. The methods in most general use are those described in the Report on Indian Fibres and Fibrous Substances.

To obtain strictly accurate comparative tests as to strength, one of the machines which have been specially designed must be employed, and of these that of Schopper of Leipzig or of Reeser and Mackenzie of Philadelphia are among the best.

In the former the fibre is fixed in a vertical position between two jaws, of which the upper is fastened to the end of a horizontal beam, while the lower is attached to a piston which moves in a cylinder and is raised or lowered by hydraulic pressure. A needle or pointer attached to the beam is moved over a graduated scale as tension of the fibre increases. As soon as the fibre breaks, the pointer stops and thus registers the breaking strain on the scale. At the same time the elongation undergone by the fibre before it breaks is likewise recorded.

The strength of cotton is usually, however, tested by hand, and experts, through long practice, can usually form remarkably accurate judgments sufficient for most practical purposes.

Length

Cotton is usually classified according to the length of the individual fibres into three main groups :—

"A"—Long staple.
"B"—Medium staple.
"C"—Short staple.

Long staple cottons are from $1\frac{1}{2}$ to $1\frac{1}{4}$ inches in length; medium from 1 to $\frac{3}{4}$ inch, and short from $\frac{5}{8}$ to $\frac{3}{8}$.

Under Long staple varieties are found—Sea Island cotton, Egyptian cottons and the "Improved" American vareties which have been obtained from the ordinary Upland types by selection and careful cultivation.

Brazilian and Peruvian cottons form an intermediate group between Long and Medium staple, for they vary in length from $1\frac{1}{2}$ to 1 inch.

The **Medium staples** are chiefly represented by the ordinary American Upland varieties.

The **Short staple** comes mostly from the East Indies.

The scientific names for the plants from which these cottons derive are given below, but only the principal groups have been mentioned. Indeed, considerable confusion exists as to the exact number of true species which actually exist. Thus while Linnaeus considered that only five species existed, Todaro gives fifty-four, the Index Kewensis 1908 gives forty-five, while Watt, in *Wild and Cultivated Cotton Plants of the World*, mentions forty-two species.

Hybridization has further complicated matters ; thus the Egyptian cottons are usually considered to be varieties of *Gossypium barbadense* crossed with other species, but Fletcher considers that they are the product of Sea Island cotton (usually considered to be *Gossypium barbadense*) with *G. vitifolium*.

Again, the ordinary Upland cotton is generally considered to be derived from *Gossypium hirsutum*, Linn., but as over a hundred varieties of Upland cotton have come into being through careful selection and cultivation, often assisted by crossing with distinct species such as *G. mexicanum* or *G. vitifolium*, it is evident that a really scientific classification is impossible.

When we turn to the Indian cottons, we find the scientific botanists equally divided, and amid the general diversity and conflict of opinion evinced by scientists, the practical business man may be well excused if he prefers to ignore the question of species and contents himself with the simpler, practical test of length, strength and price in the sale-rooms.

CHAPTER II

THE COTTON PLANT:

ITS PRODUCTION AND PREPARATION FOR THE MARKET

The Cotton Plant

THE cotton plant is a perennial shrub, but it is usually treated as an annual. The flowers of the shrub vary considerably in colour according to the species.

Thus the typical American Upland varieties have flowers with white or pale yellow petals when the bud opens, but these gradually become darker and red till they fall to the ground, which happens on the third or fourth day.

Indian varieties usually have yellow flowers with crimson spots, but the tree cotton of Africa and India (*Gossypium arboreum*) has flowers of a deep purple-red.

The Sea Island cotton and its derivative Egyptian varieties have flowers which are usually similar in colouring to the Indian varieties.

Whatever the colour of the flower, the subsequent history of the cotton plant is the same.

When the petals fall the fruit remains enveloped in the calyx, but gradually increases in size, when it is called the "boll."

When the "boll" is ripe the outer covering splits, exposing the cotton, which, now that it is no longer restrained, expands rapidly and forms a large fluffy ball.

When the "boll" has opened completely and is dry, the cotton is ready for gathering.

Inside the ball of fluff are the actual seeds of the cotton plant. So long as the cotton fibre is still adhering to them the product is known as "seed cotton."

The first process is that of "ginning," by which the cotton fibre, now called "lint," is removed from the actual seeds. This "lint" constitutes the "raw cotton" of commerce.

The seed cotton usually contains in weight two-thirds seed and one-third fibre.

Some Products of Cotton Seed

The seed now forms an important raw product and is used for many purposes.

They vary considerably in size, colour, etc., the most striking diversity being that, whereas some, such as the Indian and American Upland varieties, are covered with short, downy hairs known as "fuzz," which remains after the lint has been removed by ginning, other varieties such as Sea Island and the Egyptian are almost entirely free from this covering.

Generally the shorter staples have most "fuzz," and it has been noticed that as the length of the staple is increased by careful cultivation the seeds tend to lose their fuzzy character. This is particularly noticeable with some of the Improved Upland varieties.

This fuzz varies in colour from white to green, grey or brown.

The Upland cotton seed, after ginning, is passed through another machine called a "delinter," which removes any remaining cotton and also most of the fuzz. The product of this process is known as "linters" or "scarto."

Linters are used in the manufacture of cheap yarns for carpets and other articles and also for making paper.

In addition the process improves the quality of the seed itself by rendering the husks or "hulls" more suitable for cattle food. It likewise facilitates the handling of the seed and retards fermentation during storage.

The chief value of cotton seed lies in the fact that it contains 20 per cent. of oil, which is used for soap making and other purposes.

In the case of the Egyptian and other smooth varieties, the seeds can be crushed without removing the harder outer seed case or "hull," but American Upland seeds are usually hulled first. This is necessitated by the fact that a certain amount of the fuzz escapes the action of the delinter, and if allowed to remain would depreciate the value of the oil or oil cake.

A use has, however, been found for the hulls, which can be utilized for paper making, or, if ground up, may be mixed with richer cattle foods, such as cotton-seed meal.

After the oil has been expressed, the residue or "oil cake" forms a valuable cattle food.

Ginned Upland seed contains :—

10 per cent. Linters.
35·8 per cent. Hulls.
20 per cent. Oil.
34·2 per cent. Oil cake.

It will thus be seen that practically every part of "seed cotton" has a use and value.

Structure of the Cotton Fibre

The cotton fibre is a single hollow cell or tube without any transverse partition, the base of which is attached to the seed coat or hull. Its greatest diameter is at a point about one-third of its length from the base. As the fibre ripens it ceases to be cylindrical and becomes flattened, thus appearing to be a narrow ribbon with thickened rounded edges.

Its surface is smooth, and were it not that it possesses a peculiar twist it would be difficult to spin. This twist only develops after the boll has opened and exposed the cotton to the air and light. They are sometimes in one direction and sometimes in the opposite, occur at irregular intervals and vary in the degree of convolution. The number of twists in a given length of the fibre varies also, and is increased by care in the cultivation of the plant. The finer the diameter of the fibre, the greater are the number of twists, and hence Sea Island cotton, which is the finest cotton fibre grown, has the most twists of any variety.

It is this twist that gives the requisite roughness and so enables them to be spun into thread. If the cotton is plucked before it is ripe it has practically no twist. Such fibre is known as "dead cotton," and as it is weak and brittle, it tends to break up in the course of manufacture. This, of course, means actual waste of material, and further, even if made up into yarn with ripe cotton, they render the yarn weak and unable to take dyes satisfactorily.

Hence the presence of much unripe fibre greatly reduces the commercial value of a bale.

Composition of the Fibre

The chemical composition of cotton is :—

90 per cent. Cellulose.
7 to 8 per cent. Water.
0·4 per cent. Wax and Oil.
0·6 per cent. Nitrogenous matter.
1 per cent. Mineral matter.

The wax is present as a thin layer on the surface of the fibre and prevents it absorbing water easily, while the oil is identical with that contained in the seed.

Some Products of Cotton

Cotton Wool.—In order to prepare absorbent cotton wool (for dressing wounds, etc.) the wax and oil are removed by boiling the fibre with diluted caustic alkali under pressure. The fibre is then washed and treated with hydrochloric acid and bleaching powder and again washed and dried.

Mercerized Cotton.—John Mercer in 1844 discovered that if cotton was immersed in a strong solution of caustic soda it underwent certain changes of which the most noticeable was the production of a silky lustre. From this discovery grew the process called mercerization, which can be applied either to the yarn or to the woven fabric. Not only is a silky lustre thus obtained, but the material is able to absorb more dye ; at the same time there is a decrease in length accompanied by an increase in tensile strength, so much so that in many cases mercerized cotton is 50 per cent. stronger than similar untreated cotton. The effect of the process on the actual hair is to cause the flattened tube to swell out and make it once more a hollow cylindrical tube. Egyptian cotton is generally better than American for this process.

Gun Cotton.—If ordinary cotton is treated with a mixture of sulphuric and nitric acid, it is converted thereby into gun cotton. This superficially resembles ordinary cotton, but is rougher, grates when rubbed between the fingers and is inelastic. On percussion it explodes owing to the liberation of a large quantity of gas.

Collodion.—Collodion is produced from gun cotton by dissolving it in ether, or in a mixture of ether and alcohol. The product dries to a thin film and is used for the preparation of photographic plates, for the manufacture of celluloid and for a number of other purposes.

Cultivation

Cotton is mainly grown in semi-tropical or tropical areas. In the Northern Hemisphere the limit of cultivation is, generally speaking, the fortieth degree of latitude, and in the United States it is seldom found North of the thirty-seventh degree, except to a limited extent in Missouri and Kentucky.

In Europe, however, there are places where it is grown on a considerable scale, even North of parallel 40°, notably on the Southern slopes of the Balkans at latitude 42° 40′, whilst in Central Asia it grows as far North as 44° 30′.

In China and Japan, however, 40° is the limit of cultivation.

In the Southern Hemisphere no considerable quantity is grown South of latitude 25°.

Climate

As the growing and maturing of the cotton plant takes from six to seven months, a fairly equable and settled climate is necessary. The mean temperature should be between 65° and 80°, and any sudden change of temperature is liable to check development and produce premature ripening. Rainfall during this period must be such as will keep the soil moist but not wet, and therefore the best type of climate is one with much sunshine by day and light showers of rain or heavy dews at night.

Moderate showers do little harm during the earlier period of the plants' growth, but once the flowers have opened, unless dry, warm weather prevails, serious damage may ensue. At all times continuous rain or even occasional but heavy showers will be most detrimental.

Once the plants have reached full size, a drier condition of the soil and a lower temperature are necessary so as to check growth and enable the " bolls " to develop.

Lack of sunshine or early frosts are equally detrimental, and it will therefore be seen that considerable care should be taken in choosing the site of a plantation. It should be so situated as not to be exposed to strong winds, which might unduly dry the soil or injure the plants.

Soil

A soil which contains a fair proportion of sand is highly desirable. It should be finely divided and thoroughly intermingled with the other constituents. If there is too much humus, the plants tend to run to foliage rather than to fruit, which means that but little fibre is produced. Stony or rocky ground on the one hand, and clay soils on the other, are equally to be avoided. If the soil be too sandy it will be unable to retain sufficient water and the resulting crop will be poor. Nevertheless, surprisingly good results are obtained often from apparently unsuitable soil when sufficient care has been devoted to cultivation.

The ideal soil, however, is a deep medium loam with good natural drainage, which will retain enough moisture to supply what the plants require.

The Upland cottons of the States do best on soils containing from 10 per cent. to 12 per cent. of moisture during the growing season, while the Sea Island cotton requires a lighter soil with about only 5 per cent. of moisture.

System of Cultivation

The essential factor in any system of cultivation is to adapt the soil to the requirements of the plant. Thus, if the soil is hard or stiff, it must be well broken up so as to enable the roots to penetrate freely. Sandy soil, on the contrary, usually requires the addition of humus.

Weeds must be carefully eliminated, as if left to grow they rob the plants of moisture and food, hence a cotton field entails considerable labour.

The system in vogue in the U.S.A. may be regarded as characteristic throughout the world, despite certain varieties necessitated by local conditions. The other most noticeable variation is in Egypt, due to the fact that cotton there is largely grown either on soil which has been recently flooded by the Nile or else on irrigated land.

As the States are still the greatest producers of cotton in the world, a detailed description of the methods in vogue there may be considered first.

System in the U.S.A.

Climatic conditions vary considerably. The rainfall, however, is generally adequate, and except in California and Arizona irrigation is seldom necessary.

The rain increases from spring to midsummer and then decreases, leaving the autumn dry, and so fulfils one of the chief requirements for the production of a good crop of fibre.

Soils vary considerably, but the most satisfactory are medium loams.

The land is ploughed as early in the year as possible, not less than 8 inches deep and sometimes as much as 10 or 12 inches. The aim of good ploughing is to reduce the soil to a fine tilth, and the advantage of deep ploughing is that it enables the soil to retain the moisture better, and permits the plants to extend their roots and so obtain more nourishment.

After ploughing, the soil is well harrowed, and sometimes a heavy roller is used to break up any clods. If the soil requires manure, it is usually spread over the land before ploughing and worked in by the plough.

The seed is sown in rows, generally 4 feet apart, but in light soils sometimes only 3 or 3½ feet separate the rows. The distance between the plants in the rows also varies according to the richness of the soil; in the case of good soil 20 to 24 inches being allowed, down to 12 to 16 for the poor qualities.

If, however, the plants used or the soil be such as is likely to produce unusually large bushes, the rows are set 5 feet apart and the plants 30 inches from each other.

On some estates the rows are marked by dragging a heavy wooden beam set with teeth placed at the requisite distance apart, and a light plough is then run up the marks thus made, which cuts a furrow about 4½ inches deep.

Before planting, the seeds are moistened to assist germination, and in some cases are then rolled in lime, guano or wood-ash, the object of this latter process being to prevent them sticking together.

The time of sowing varies considerably in different areas, but is usually from the middle of March to the middle of April. In the smaller plantations sowing is done by hand and needs three persons—one to make holes, another to plant four or five seeds in each hole, and a third to cover up the seeds afterwards.

In the larger plantations, however, hand sowing has been replaced by mechanical sowers, which can sow twenty acres in a day.

The seeds are covered by from 1 to 3 inches of soil, according to whether there is likelihood of drought or not. This is done by means of light hoes on plantations where a mechanical sower is not employed.

Within eight to fifteen days the young plants begin to appear, and as soon as they are 3 or 4 inches high weeding must begin. This is generally done by means of a cultivating plough which only ploughs to a depth of 1 or 2 inches, as deeper ploughing would injure the roots of the plants. After the space between the rows has thus been cleared, the ground around the plants is hoed. Unless there is a hot sun to kill the weeds, they are collected by hand and placed in heaps at the end of the rows lest they start growing again.

About a fortnight after this first weeding, the ground is again broken up by the cultivator plough, as otherwise it forms a hard crust after rain.

This process must constantly be repeated whenever weeds begin to reappear or the soil becomes caked after rain.

The next step is to thin out the plants from each group, only the strongest being left in each case, and where gaps occur fresh seeds are sown. This point reached, little work is necessary, except that the soil is heaped up round the plants by degrees by hoeing to about 4 inches above the level.

Harvesting

The date when cotton picking can begin varies in different areas, but it is usually about the middle of August and extends for some three months. The most important month, however, is October, but in some cases picking continues into January, if the capsules have not been checked by the cold.

The pickers carry a sack suspended from the shoulders, with its mouth open, into which the seed cotton is placed; but the outer case or husk of the capsule is usually left on the plant. Picking is done by coloured people, men, women and children, and the quantity an individual will pick in a day varies enormously. Thus while some pick less than 100 lb., others will pick up to 350 lb. Care is necessary when picking, to exclude leaves or fragments of capsules; for if the product be pronounced "leafy" its value is diminished.

Attempts have been made to replace the expensive hand-picking with mechanical pickers, and two of the best are the Price-Campbell and the Crawford-Elliot.

The former works by means of a series of spindles (usually corrugated), which are carried on suitable bearings, fitted into vertical cylinders, arranged on an endless band on each side of the machine. The spindles are rapidly rotated, and on coming in contact with the fibre which has burst from the ball, draws it round them and thus collects it. The cotton is next detached by a special mechanism and falls into a bag at the rear of the machine.

The picker is mounted on a trolley which is driven at a walking pace by a petrol engine, and it is claimed that it will gather 6,000 lb. of seed cotton in a ten-hours' day.

It picks about 90 per cent. of the ripe cotton and the remaining 10 per cent. is collected by going over the same row a second time. Neither the plants themselves nor the flowers or immature "bolls" are damaged.

The principal complaint against the machine is that it picks more green leaves than is done by hand. To meet this, an appliance has been invented which it is claimed, when attached to the machine, separates the leaf from the cotton.

If this proves the success it is claimed to be, the secret of producing a satisfactory substitute for hand labour would appear to be solved.

The Crawford-Elliot machine uses a row of bristle brushes instead of spindles, and its supporters claim that it will pick a field of cotton at a quarter of the cost of hand labour.

In the States the second picking is considered the best, as in the first picking there is always a certain amount of sand and soil which has been beaten up on to the lower bolls by the rain, but in Egypt, where the cotton is grown in irrigated fields, this damage does not occur and the first picking is considered the best.

The System of Cultivation in Egypt

Egypt falls into two distinct belts, Lower and Upper Egypt.

Lower Egypt consists of the Delta, which has a clay soil, distinctly saline in character, and a hot moist atmosphere.

In Upper Egypt the soil is also alluvial and has been deposited by the Nile when in flood, but it is not so rich in clay as in the Delta, while the climate is hotter and drier.

Thus in Egypt there is a great variety in the soil under cotton cultivation, ranging from the heavy black fertile clay of the Delta through mixed clay and sand to almost pure sand.

Under such conditions methods vary considerably, but all are controlled by the same factor, namely that there is very little rain and irrigation is essential.

In order to do this effectively, the land is divided into sections by two series of rough ridges running at right angles to each other.

The soil is first ploughed deeply three or four times and then thrown into rough ridges 32 to 40 inches apart. A second line of ridges intersect these, making each of the original ridges only 36 feet long. The soil must be quite dry when the seed is sown and is watered immediately after.

Sowing is usually from the middle of February to the middle of April, varying according to the locality, and before sowing, the seeds are soaked in water for twenty-four hours and any which are then found floating on the surface are rejected.

Holes are made 10 to 18 inches apart and the seeds planted about 3 inches below the surface. From eight to ten seeds are placed in each hole, which is immediately covered with soil. The plants appear above the soil in about ten days.

When the plants have become well established, the fields are hoed to destroy the weeds and loosen the soil. The hoeing is often repeated shortly before the first watering, which generally takes place thirty-five days after sowing, by which time the plants have been thinned out, only the two strongest being left in each hole. The second watering is given about twenty-five to thirty days after the first, and shortly after it the soil is again hoed. The third watering takes place about three weeks later and is followed by another hoeing. After this, during the summer, i.e. June, July and August, waterings take place twice a month. The amount of water thus artificially supplied is estimated roughly to be equal to a rainfall of 30 to 35 inches.

Methods of Watering

The water is drawn from the irrigation canals either by very primitive methods such as the lever and bucket or by rotatory pumps worked by streams or even by electricity. It is distributed throughout the farms by means of rough and rather leaky canals from which it is conducted round the fields through little ditches, and thence it runs along the furrows between the ridges. The cotton grows on the tops of these ridges, which always remain above the water.

Gathering the Cotton

As all the bolls do not ripen at the same date, picking extends over two months or more, the work being done by women and children. There are usually three pickings at intervals of a month. In Upper Egypt picking begins at the end of August, but in the Delta the first crop is gathered towards the middle of September and the last picking is in November.

In the first picking about 35 per cent. of the total is gathered, and in the second about 45 per cent. Both these pickings are of good quality and greatly superior to the third picking, representing 20 per cent. of the total, for which reason the latter is sold separately.

Manuring

Owing to the fact that the roots, stems, leaves and the husks of the bolls are returned to the soil, a great deal of manure is not required.

Nitrogen, potassium and phosphorus are the chief requirements, but since there must also be a considerable amount of humus in the soil, stable manure is generally found the most suitable type to apply as a basis. It is liberally spread over the soil before the last ploughing before the sowing commences.

In addition, soluble nitrogen is often added, as the young plants cannot obtain the necessary nitrogen rapidly enough from the stable manure. In cases where a leguminous crop such as clover has just preceded the cotton crop, additional nitrogen is not necessary, and in any case only a moderate amount of insoluble nitrogen must be added, as otherwise the plants tend to run too much to foliage.

Nitrate of soda and sulphate of ammonia are nitrogenous manures most suitable for cotton, about 80 lb. of the latter or 100 lb. of the former being sufficient for an acre.

Phosphorus is, however, the chief artificial manure required on a cotton plantation, and the most usual form is superphosphate of lime, which is most effective if employed in conjunction with potash and nitrogen.

Phosphorus checks any tendency to a coarse growth, encourages ripening and improves the quality of the fibre. The amount used varies according to circumstances from 200 lb. to as much as 500 lb. an acre.

Potassium is seldom applied alone, its chief use being found to be in conjunction with phosphorus and nitrogen. Kainit or muriate of potash are the forms usually employed, from 50 lb. to 200 lb. an acre being required.

Rotation of Crops

It has been found by experience that it is far wiser to have a rotation of crops than to keep on planting cotton on the same ground year after year. The reasons for this, though not yet fully understood, are in part due to the different nutritive constituents withdrawn by various crops, and in part to the activity of various bacteria and insects.

The general principle to be followed is that a long-rooted crop like cotton should be followed by a crop with shallow, spreading roots, like oats or clover.

In Egypt the most usual system is a three or four years' rotation, in which clover is followed by cotton, and beans or fallow are interspersed between the next cotton crop.

In America in the first year maize is grown, in the second year winter oats, followed by cow-peas, and in the third year cotton.

Improvements of Cotton

When a new area is about to be opened up as a cotton growing district, attention should first be directed to any native cotton plant which appears capable of improvement, as usually it will be found better suited to the climate and soil than foreign plants which will need to be acclimatized.

The first step is careful seed selection, as considerable improvement can be effected by the comparatively simple process of picking the biggest and best developed ripe seeds for sowing.

But still better results are obtained if, instead of merely going over seed already collected, selection begins in the field itself, by choosing the best seeds from the most vigorous and prolific plants or from those which exhibit certain desirable quality. Thus considerable increase in the length of the staple is obtainable by selecting seeds of only those plants which produce the longest fibre.

If this process is repeated each year, before long a type of cotton will be established in which the improved qualities will remain so long as care in cultivation and selection of seeds is maintained.

If, however, it is decided that the country does not produce a native type of satisfactory quality, foreign varieties will have to be imported. When choosing these, considerable care must be devoted to studying the soil and climate, so that only varieties known to grow well under similar conditions shall be imported.

At first, it is usually found that exotic varieties tend to deteriorate, and to counteract this tendency only seeds from such plants as produce a good crop should be selected for sowing. In course of time the plants will become accustomed to the new conditions and prove hardier than their predecessors.

During this experimental period careful observations should be taken of the effect of different soils and situations on the date of flowering and fruiting. Above all, careful note should be taken of the length of time required by the whole to ripen.

Competent botanists have secured remarkable improvements by artificial hybridization or pollination, but practical growers without the necessary knowledge or time should not attempt this kind of improvement. The crossing is effected by removing the petals and stamens from a flower-bud of one of the plants chosen as the parent form, leaving the pistil standing. The flower is next covered with a paper bag which is fastened round the stem by a fine wire. An expanding flower of the other parent plant is also covered with a paper bag, and after a day or two is cut off and taken to the flower which has already been specially treated.

Both bags are now removed and the pistil of the prepared flower is dusted with the pollen of the other. The seed which results is carefully planted and furnishes a number of different forms, and from these a single plant is chosen which exhibits the desired qualities. The seed from this plant alone is used for further improvements. The seed of the second generation is again selected, and after a series of such selections, a satisfactory strain may be established.

Many experts, however, place little reliance on artificial hybrids and prefer to improve the known varieties by selecting seeds from desirable plants. But with the more thorough knowledge of Mendel's laws, it is quite probable that before long results may be achieved commensurate with the time and labour involved.

Perennial Cotton

Although the cotton plant was originally a perennial, in most important areas it is now treated as an annual. It was observed that by planting afresh each year a more regular crop was obtained, and also in any climate where the cold is sufficient during winter to kill the plant, replanting became inevitable. But there are other excellent reasons which led to the change: thus since as an annual it only occupies the ground for six or seven months, other crops can be grown on the same areas which not only is profitable in itself, but improves the crop by a system of rotation. Further, the ground can be thoroughly cleaned after each crop, thus materially reducing the risk of disease.

In recent years some interesting experiments have been made in Hawai with perennial cotton, especially in the propagation of the plant by cuttings and by budding.

In Brazil and Peru perennial tree cotton is still grown on a commercial scale, and will be referred to in more detail in the sections dealing with those areas.

Diseases and Pests

The numerous diseases which attack the cotton plant may be divided into three classes :—

1. Diseases due to Physiological Causes.
2. Fungoid Diseases.
3. Insect Pests.

1. **Diseases due to Physiological Causes.**—These may be defined as diseases due to a deficiency in certain kinds of nutriment, and besides the immediate symptoms revealed, they lead to a weakening of the plant which renders it more liable to succumb to the attacks of fungoid diseases or insect pests.

The most important diseases which fall within this class are :—

(1) Mosaic disease.
(2) Red leaf blight.
(3) Shedding of bolls.
(4) Angular leaf spot.

(1) MOSAIC DISEASE.—This is shown by the appearance of yellow spots on the leaves which occur in a fairly regular pattern and thus produce a kind of mosaic, hence the name. As the disease progresses the leaves usually curl up and fall to the ground. Plants thus attacked are usually assailed by fungoid organisms as well.

Remedy.—The most effective remedy is careful and thorough cultivation, with the object of improving the physical condition of the soil. The application of kainit to the ground is beneficial largely because it binds the particles of soil more closely together, enabling it to retain moisture, and for the same reason some planters roll the land.

(2) Red Leaf Blight.—In this disease the leaves turn red, the plant ceases to grow and finally the leaves begin to fall. Its cause is poverty of the soil, particularly in potash and nitrogen, and probably also in phosphoric acid.

Remedy.—The remedy is to supply these necessary constituents by manuring.

(3) The Shedding of Bolls.—This is caused by drought or excessive rainfall, and no man-devised remedy seems available. If due to drought, artificial watering, if possible, may check the shedding, if the disease has not obtained too firm a hold.

(4) Angular Leaf Spot.—In this disease dark angular spots appear on the leaves which at first have a watery appearance, but later become black and then brown. It seems to be always the weaker plants which are attacked.

Remedy.—The methods of cultivation may generally be considered unsatisfactory and greater care in the selection of seeds and in the cultivation of the soil is needed.

2. **Fungoid Diseases.**—These diseases are caused by the attacks of various fungoid growth, the most important being :—

(1) Wilt or frenching.
(2) Cotton leaf blight.
(3) Mildew.
(4) Cotton boll rot.
(5) Anthracnose.
(6) Root rot.

(1) Wilt or Frenching.—Wilt or frenching is caused by *Neocosmospora vasinfecta*, a fungus which enters through the roots and grows up into the stems and branches. It interferes with the circulation of the sap and so prevents the plant obtaining the necessary nutriment. The first signs of the disease appear on the lower leaves whose under-surface turns yellow. The leaves affected die and fall off, and in extreme cases all the leaves fall off and the plant dies. If the stem of the plant is broken, the fibro-vascular tissues are seen to be light brown in colour.

Remedy.—The only effective remedy is the production of a variety able to resist the disease. This has been done in the United States, and it was hoped that the Sea Island cotton industry had been saved by the production of a wilt-resisting variety; but the boll weevil has now decimated this crop.

(2) Cotton Leaf Blight.—Cotton Leaf Blight is caused by the fungus *Sphaerella gossypina*, which usually attacks the older leaves of the plants or any which have been injured, and is therefore often found attacking plants already affected by the Mosaic Disease. The leaves are covered with small spots which are white or pale brown in the centre and reddish at the edge. This is a common disease on cotton plantations, but does not often cause serious injury.

Remedy.—Improved methods of cultivation generally check this malady.

(3) Mildew.—Mildew is caused by the fungus *Ramularia areola*, but affects the crop little. It appears on the surface of the leaves in small areas bounded by the veinlets.

(4) Cotton Boll Rot.—Cotton Boll Rot is a much more serious matter; like the kindred *Black Arm* and *Bacterial Disease*, it is caused by *Bacterium malvacearum*. It first manifests its appearance as a small, dark brown patch on the boll near the peduncle. If it begins before ripening takes place, the boll does not open, and the immature fibre decays. If, however, it commences later, only part of the boll is affected and some of the cotton may be produced.

Remedy.—No really efficient method has yet been devised to deal with this malady.

(5) Anthracnose.—Anthracnose is caused by the fungus *Colletotrichum gossypii* and may appear on stems, bolls or leaves.

When it attacks the stems, reddish brown patches appear on the bark, and if the attack is severe, the leaves turn yellow, wither and fall. This form of the disease does little damage to well-matured plants, but in the case of young seedlings the damage may be serious.

When it attacks the bolls it takes the form of small reddish brown spots, depressed in the centre. These increase in size and turn black in the middle, while the edges retain a pinkish hue. The effect of the disease when it attacks bolls before they have attained their full size is to cause them to become deformed, and in some cases the fungus penetrates the seeds and results in ruining both seed and fibre. The disease generally occurs in warm, damp weather, just when the bolls are developing and ripening.

Remedy.—No direct remedy has been discovered, but the following preventive measures have been noted :—

The fungus is seldom prevalent in fields in which the plants are set well apart, enabling them to receive plenty of light and air. Soil treated with artificial manures containing phosphates and potash produces hardy plants better able to resist the fungus.

When a crop has, however, become affected, after the cotton has been picked, all the stalks and other remains of the plants should be collected and burned, and cotton should not be sown in such a field during the next year.

(6) ROOT ROT.—Root Rot is caused by the fungus *Ozonium sp.*, which attacks other plants besides cotton, as for example apple trees and lucerne. It grows on the roots and eats up their tissues so that they wither and decay. The roots of a plant which has been killed by this disease show numerous small white excrescences on the surface.

Remedy.—The only method of preventing the spread of the fungus is by a careful rotation of crops. Cotton should not be sown more than once in every three or four years in districts which have been infested with root rot, but cereal crops which are not attacked by the fungus should be grown during the intervening periods.

3. **Insect Pests.**—The cotton plant is, unfortunately, subject to attack from many insect pests, and some of these are among its most deadly enemies.

The most important are :—

(1) Cotton boll worms.
(2) Cotton boll weevil.
(3) Cotton worms.
(4) Cut worms.
(5) Locusts.
(6) Cotton stainers.
(7) Cotton aphis.
(8) Leaf-blister mite.

(1) THE BOLL WORMS.—These are some of the most destructive of all the diseases and pests which afflict the cotton plant.

There are many varieties, but the most notorious are :—

(1) The American boll worm (*Heliothis armiger*).

(2) The Egyptian boll worm (*Earias insulana*).

(3) The Indian boll worm (*Earias fabia*).

(4) The Pink boll worm (*Gelechis gossypiella*).

Of these the first and the last named have done the greatest damage in recent years.

The American boll worm (*Heliothis armiger*) attacks not only cotton but peas, beans, maize and numerous other plants. This fact is of importance, for it means that it is not sufficient to substitute peas for cotton on an afflicted area, as is often the case with other pests such as the boll weevil.

The eggs are laid on the under-surface of the leaves and the caterpillar emerges a few days later and at once begins to feed on the leaves, thence it soon reaches a boll into which it bores. When it has devoured this it migrates to another boll, and in the brief course of its life as a caterpillar—only two to three weeks—it can do an enormous amount of damage. When fully grown it is often 1½ inches long, and it then descends and enters the ground, where it becomes a chrysalis. About a month later it emerges as a moth and soon starts laying its eggs on the cotton plants.

Its natural enemies include certain parasitic insects and a number of birds such as the woodpecker.

Remedies.—An effective method is to plant "trap crops," of which the most popular is maize. The moths seem to prefer the silky tassels and young ears of the maize to the cotton plant, and by planting patches of maize near the cotton at such a period as will result in the tassels being formed when the cotton bolls are developed, the moth can generally be induced to lay its eggs on the maize. As soon as the eggs have been deposited, the ears are gathered and burnt. By arranging a series of maize patches the pest can be greatly reduced, if not entirely eliminated.

Another plan is to spray the cotton plants with a solution of Paris Green in the proportion of 1 lb. to 50 gallons of water. This must be repeated about once every seven to ten days. Lead arsenate is also sometimes employed, and another method of applying the poison is to dust the plants with this powder, 2 to 3 lb. being used to an acre.

Care must be taken, however, as an excessive quantity injures the plants. This method is not in high favour in America, as many of the insects being hidden in the bolls escape. It is rather regarded as a last resort when the "trap crop" method has failed or been omitted. In such cases it often saves the crop from being entirely destroyed.

Allied forms of the cotton bollworm have also done considerable damage in Egypt, Nigeria, Ceylon and India. In the latter country "Bhindi" (*Hibiscus esculentus*) has been found to be a very effective "trap crop."

The pink boll worm (*Gelechis gossypiella*) attacks the seeds in the boll. It does not seem to have reached America,* but it has done considerable damage in Europe, Asia (including India) and in Africa. Egypt in 1913 suffered more from this pest than from all the others put together.

Remedy.—The best method is to pick off the bolls and burn them as soon as they have been attacked. Spraying with arsenate is also advantageous, but to control the pest it is necessary not only to kill the larvæ in the cotton seed, but also to destroy the hibernating worms which are in the bolls left on cotton stalks, which are often kept and stacked for fuel.

Perhaps the most effective method of killing the larvæ in the seed is to fumigate with carbon disulphide, sulphur dioxide or hydrocyanic acid. Other methods which have also proved successful are: (*a*) to immerse the seeds in "cyllin" solution of 0·1 per cent. for twenty-four hours, or (*b*) treatment with hot air at a temperature of 80° C.

With regard to the Egyptian and Indian boll worms, as already indicated, their effects are similar to the American, and the best remedies are similar.

(2) THE BOLL WEEVIL.—This pest rivals the boll worm for the position of being the most destructive insect pest which affects the cotton planter. *Anthonomus grandis*—to give it its scientific name—originated in Mexico, whence it spread into Texas in 1892. Since then it has travelled at a fairly uniform rate of forty to seventy miles a year and is steadily spreading.

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* It was announced at the Cotton Congress at Zurich on June 10, 1920, that the pink boll worm had just appeared in America and the results were likely to be serious.

In 1913 the total area affected was 296,000 square miles, or 47 per cent. of the whole cotton crop acreage of the States and it is feared that by 1935 the whole area will be affected. As already the annual loss due to this pest alone is estimated at 200 million pounds of cotton, the seriousness of the pest to all, whether growers or users of cotton, will be recognized.

The boll weevil is a small grey-brown beetle, about ¼ inch long, which remains on the cotton plant until the end of the season, when it hibernates among the rubbish lying on the plantation or in the neighbouring hedge or haystack.

In spring the beetle emerges from its lair and the female eats into a cotton boll and in the cavity thus made lays her eggs. These hatch in about three days, producing a whitish grub, which immediately begins to feed on the tissues of the boll. In seven to twelve days it changes into a chrysalis, and some five days later the beetle emerges. Within another five days it is ready to start laying eggs, and thus it spreads during the season with great rapidity.

Fortunately there are a number of natural causes which tend to check its increase. Of these frost is one of the most powerful, and it is believed that not more than 3 per cent. of those which hibernate survive. Insect enemies, many of them parasitic, account for a great many weevils, and the heat of the sun tends to kill the larvæ contained in bolls which fall to the ground. Therefore, in dry hot seasons the weevil is kept in check, and care should therefore be taken to have the plantation as little shaded as possible.

Remedies.—Fine powdered arsenate of lead scattered over the plants has been found beneficial. All plants should be pulled up and burnt at the end of each season, as well as weeds or any rubbish which might act as a shelter to the weevil during the winter.

As the ravages of this pest are more marked towards the end of the year, when they have had time to multiply, early ripening varieties of cotton should be sown in areas liable to its attack. If necessary, these should be forced to early maturity by the application of manures, and a considerable space should be left between the rows as well as between the individual plants.

Some authorities recommend the picking off of the early bolls which have been attacked.

Special precautions should be adopted in areas which are as yet free from this pest to prevent the introduction of the boll weevil with imported seeds. In Nyassaland and the former German East Africa, the importation of American seeds has been forbidden, and in many other areas all imported cotton seed must be disinfected.

(3) COTTON WORMS.—The most important varieties of this pest are :—

(*a*) The American cotton worm (*Alabama argillacea*).
(*b*) The Egyptian cotton worm (*Prodenia litura*).
(*c*) The Indian cotton leaf-roller (*Sylepta derogata*).

(*a*) *The American cotton worm* is a bluish-green caterpillar with black stripes or small black spots on its back. It feeds on the leaves and often strips the plants bare. As the moth lays about 500 eggs and there are usually six generations in a season, if unchecked, it is capable of doing tremendous damage.

Fortunately, both larvæ and eggs are attacked by many kinds of parasitic insects.

Remedies.—The most successful artificial remedies consist in applying various poisons, as in the case of the boll-worm. The most popular poison is Paris Green, which is usually dusted on the plants in the form of a fine powder.

(*b*) *The Egyptian cotton worm* attacks "berseem," or Egyptian clover, as well as cotton. The moth proceeds differently to the American cotton worm, for, whereas the former lays its eggs on nearly every leaf of the plants and seldom more than three or four to a leaf, the Egyptian "worm" lays its eggs on the underside of the leaf in batches of two or three hundred. Moreover, the chrysalis hides in the soil instead of in the folds of a leaf, as is the case with the American variety.

Remedy.—The soil should be prepared as long as possible before the seed is sown. The plants should be examined every few days and all leaves which have eggs deposited on them should be collected and burnt. As great difficulty was experienced in getting sufficient labour to do this work, the Egyptian Government issued a decree making this work compulsory, and also the employment of children to do the work at definite periods.

(*c*) *The Indian cotton leaf-roller* is likewise the caterpillar of a moth, and its depredations have also been noticed in South Nigeria and East Africa.

Remedies.—In its early stages it may be checked by picking off affected leaves and burning them, but if the pest obtains a firm foothold the plants should be sprayed with arsenate of lead.

(4) CUT WORMS.—These are the larvæ of certain moths such as *Agrostis ypsilon*, which eat off the young seedlings just as they are appearing above the soil.

Remedy.—As they feed only at night, one method is to place poisoned cabbage leaves on bunches of grass in the infested portions of the cotton fields. The larvæ hide under these during the day and are thus destroyed. In Egypt, the addition of a small quantity of petroleum to the water used for irrigation has also been advocated.

(5) LOCUSTS.—These locusts are too well known to need any description.

Remedy.—The best method of dealing with this plague is to place small heaps of bran mixed with molasses and arsenic on the ground. Spraying with Paris Green has also been found effective.

(6) COTTON STAINERS.—These fall into two main groups:—

(*a*) The large cotton stainers (*Dysdercus spp.*).
(*b*) The lesser cotton stainers (*Oxycarenus spp.*).

(*a*) *The cotton stainers* are found in many cotton-growing countries. In the early part of the season the insects attack the buds or young bolls and suck the sap. In consequence, they cannot develop properly. When the bolls are opening they attack the seed and stain the cotton with their yellow excrement.

Remedy.—Heaps of cotton seed or sugar-cane should be placed on the ground; large numbers of insects will be attracted to them and can then be destroyed by pouring on them boiling water or kerosene.

(7) COTTON APHIS (*Aphis gossypii*) attacks the young plant, especially the leaf, buds and young leaves. By sucking the

sap from young plants it often does considerable damage, but healthy plants usually withstand the attack. The ladybirds and their larvæ feed on these insects and greatly diminish their numbers.

Remedy.—A solution of soap and kerosene should be applied if the attack is at all serious. Half a pound of soft soap dissolved in one gallon of boiling water should be poured while still hot into two gallons of kerosene. After beating this up into a creamy liquid, it should be forced through a fine spray nozzle into another receptacle. This makes it a fairly permanent mixture which can be diluted with ten to twenty times its quantity of water and sprayed on the plants.

(8) LEAF-BLISTER MITE (*Eriophyes gossypii*).—While not strictly insects, these mites are included here for convenience. They are so small as to be invisible to the naked eye and make their presence known by causing the leaves to curl up and appear blistered. These blisters or galls in time turn reddish brown and contain the mites, who also lay their eggs in them. These blisters or galls are not confined to the leaves but may be found on any part of the plant except the roots. Fortunately they do not as a rule do much serious damage to full-grown plants, but if they appear in the early stages of growth may do serious damage.

Remedy.—Gathering and burning the affected leaves is the best method in such cases, and the application of a mixture of sulphur and lime is also found beneficial.

Disinfection of Seed

Reference has already been made to the desirability of disinfecting seed imported from another cotton-growing country. This should always be done even if it is not legally compulsory, and the following are the most usual methods employed :—

(1) **Fumigation with carbon disulphide** is largely used in America, but its application requires considerable care, as it is liable to cause explosions if carelessly handled. It is most efficacious in destroying insect pests, including the dreaded boll weevil. An apparatus is now employed which passes a mixture of carbon disulphide vapour and air through the sacks of seed in such a manner as to reach every part.

(2) **Fumigation with hydrogen cyanide** is in vogue in Uganda. At Entebbe an air-tight chamber about 8 feet square has been built, furnished with movable trays for the seed. Trap-doors have been made in the roof to enable the vapour to escape after the fumigation is finished. Entrance to the chamber is through a door in front, and the vapour is admitted through two small side-doors. The mixture is composed of sulphuric acid, potassium cyanide and water. As this vapour is exceedingly poisonous, great care is necessary when handling it.

(3) In the West Indies the chief danger feared is the spread of fungoid diseases from one island to the other, and the method employed is therefore different. A solution of mercuric chloride (corrosive sublimate) is used; one part by weight of mercuric chloride is dissolved in 1,000 parts of water (one ounce in seven gallons). The seeds are soaked for twenty minutes in the solution, then washed in water and spread out to dry in a thin layer, either on a clean floor or on clean canvas in the shade. While drying, the seeds must be turned over from time to time. This solution is also very poisonous, necessitating great care when handling it.

(4) In Egypt special measures have been adopted for checking the spread of the larvæ of the pink boll-worm. A special plant has been devised for treating the seed with hot air at a temperature of about 80° C. This and other methods employed have already been described in the section dealing with this pest.

CHAPTER III

COTTON GROWN WITHIN THE BRITISH EMPIRE

(A) EGYPT

EGYPT and India are at present the most important cotton producing areas within the Empire. Of these India produces the largest amount, but the high quality of Egyptian cotton renders it the most important to British manufacturers.

Although cotton has been grown in Egypt for over two thousand years its systematic cultivation really dates from 1820, in which year Jumel, a Franco-Swiss engineer, drew attention to the fact that tree cotton was grown in the native gardens, and suggested that it should be grown on a commercial scale or even replaced by superior varieties and grown extensively. He persuaded Mohammed Ali, the founder of the late Egyptian dynasty, to support the scheme, and he at first contented himself with a systematic extension of tree cotton. This proving successful, Mohammed Ali imported foreign seed, mostly Sea Island and Brazilian. The result of these experiments has been the development of a distinct Egyptian cotton which, although possessing numerous varieties, is characterized by the length and strength of the lint, by fine quality and silky texture, and is generally brown in colour. To-day it has established a special market for itself and a high reputation as a fine grade cotton.

The American Civil War gave Egyptian cotton its opportunity. Although the high prices then being obtained subsequently fell, Egyptian cotton had become recognized as peculiarly suitable for special uses and has been in steady demand ever since. It was not, however, till improvements in spinning methods rendered the production of finer yarns and fabrics possible that Egyptian cotton became of prime importance. The demand was further increased by the development of the sewing cotton trade, for which Sea Island cotton was unable by itself to supply all the raw cotton required.

About the beginning of the twentieth century the revival of mercerizing, for which Egyptian cotton was at first essential, increased the premium on Egyptian cotton over American. By 1907 the average price for Fully Good Fair Brown, which is the basis price for Egyptian cotton, was 10·37*d.* or 63 per cent. above American middling, and in 1910 it even reached 67 per cent. above the American average. The reasons why Egyptian cotton is always higher in price than American is due to the small supply compared with the demand, and this scarcity is due to the great difficulty of increasing the crop sufficiently fast to keep pace with the ever-increasing demand.

This position is due to the limited water supply, which again governs the amount of irrigation possible and therefore the amount of land available.

The total area of Egypt is over 350,000 square miles, but of this not more than 12,000 square miles can be considered cultivable, the rest being desert. The climate being practically rainless the available land is restricted to the valley of the Nile, and as that river has not a single tributary in Egypt, this implies (1) a strip often not more than a mile wide on each bank, stretching from Assuan to Cairo, a distance of some 550 miles, and (2) the Delta stretching in a fan from Cairo to the sea. It is this second area which produces three-quarters of the total crop of Egypt, although the Delta contains only some 4,000 acres.

Any possibility of growing cotton at all was dependent on an entire alteration in the methods of irrigation in vogue in Egypt. The traditional system was by "basins" or large enclosed areas flooded by the rise of the Nile. The water thus collected was allowed to lie upon the ground for about forty days and was then run back into the Nile as the flood receded, leaving a layer of rich silt over the land. This system gave excellent winter crops, but hardly anything in the summer, and moreover it left the country absolutely dependent on the height of each flood.

Further, such a system absolutely precluded any possibility of growing cotton, since it entailed an insufficient supply in summer when the crop was growing and the submersion of the land just when the crop was ripening.

Mohammed Ali therefore introduced the new system of "perennial" irrigation based on canals instead of basins. This was highly successful, but as it was essential that the canals should be cleared of the silt deposited at each flood, Mohammed Ali introduced the corvée system of forced labour, which soon developed into one of the most monstrous abuses ever perpetrated in the land of the Pharaohs.

To reduce the evils of this system a French engineer, Belleonds de Linaut, in 1833 conceived the idea of the Delta Barrage, which was, however, not finally repaired and completed till 1890 by Sir Colin Scott-Moncrieff. Despite its earlier failures this Barrage has more than justified the time and money expended on it, and its ultimate success has led to the erection of similar dams, with the consequent increase in acreage of cultivable land in Egypt. Among these, mention must be made of the great Assuan Dam, the Zifta Barrage on the Damietta branch of the Nile, and the barrages at Esna and Assiut which have increased the available area in Upper Egypt.

As a result of the improved system of irrigation a far larger area has been brought under cultivation in the last quarter of a century, but unfortunately this increase in area has been accompanied by a decreased production per acre, as the following figures will show :—

Year.	Acres planted.	Total produced.	Average yield for 3 years.
1895–6	1,035,649	522,600,500 lb.	531 lb.
1901–2	1,297,380	630,939,700 ,,	463 ,,
1906–7	1,563,530	688,336,400 ,,	407 ,,
1912–13	1,787,244	746,135,700 ,,	424 ,,

This decreased yield per acre was rendered the more serious by a marked deterioration in the quality of the crop. The chief cause is believed to be due to overwatering and insufficient drainage, resulting in the subsoil becoming water-logged. This cause is now recognized by the Egyptian Department of Agriculture, and strenuous efforts are being made to deal with the situation, which has also been complicated by the ravages of insect pests, particularly the cotton and boll worm, by the degeneration of the plant in certain areas, due probably to insufficient care in the selection of seed, by lack of adequate manures, and in certain districts to the ill-advised attempts of some of the fellahin to grow cotton on a biennial instead of a triennial rotation. The distribution of Egyptian cotton in 1913, the last normal, pre-war year, was as follows in thousands of pounds:—

Total 690,644

Great Britain	296,794	Spain	15,812
The U.S.A.	66,712	Belgium	2,437
Germany	65,878	Holland	2,400
France	65,001	British India	713
Russia	59,420	Portugal	700
Austro-Hungary	42,795	Turkey	442
Switzerland	27,141	Greece	191
Italy	26,340	Other Countries	92
Japan	17,776		

The Chief Egyptian Varieties

Egyptian cotton is next to Sea Island cotton in quality and is used for the world's finer cotton goods. The largest user is England, which has more spindles engaged on Egyptian cotton than all other countries put together.

The chief commercial varieties are: Mitafifi, Abassai, Joanovich, Ashmouni, Nubari, Assili and Sakellaridis. Of these Sakellaridis, although a cotton of quite recent development, is now the most important.

Besides the cotton introduced in 1820 by Jumel and so named after him, "Sea Island" was introduced two years later and Brazilian in 1827.

From these varieties the first distinctly Egyptian cotton was evolved and became known as "Ashmouni."

In 1914 the approximate areas devoted to each of these varieties was as follows:—

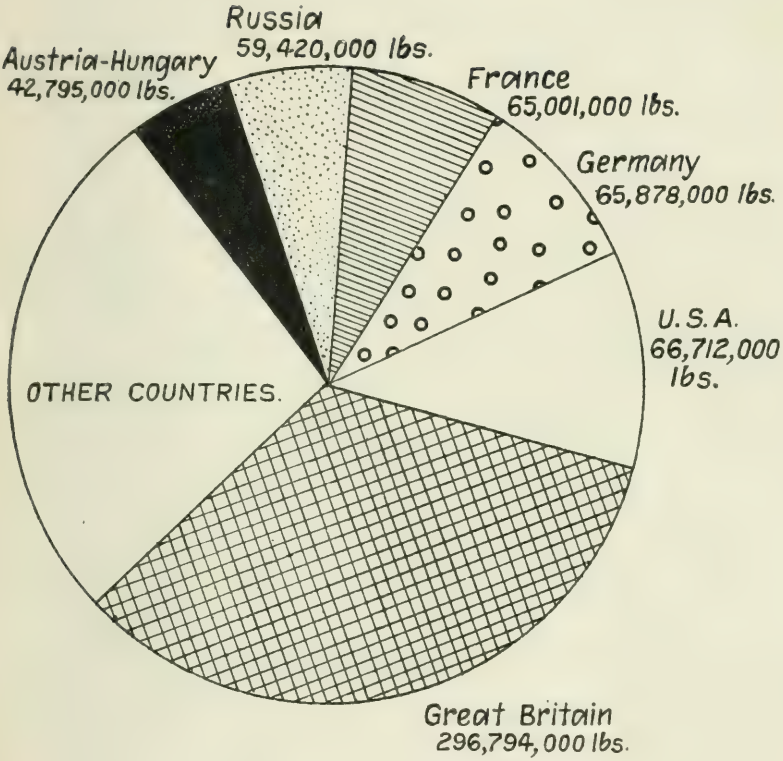

CHART SHOWING
SIX LARGEST CONSUMERS OF EGYPT'S
COTTON CROP……………………1913.

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Mitafifi	485,109	acres
Abassai	12,748	,,
Joanovich	132,377	,,
Ashmouni	367,330	,,
Nubari	271,722	,,
Assili	139,200	,,
Sakellaridis	409,390	,,
Other sorts	4,094	,,
	1,821,970	,,

Considering each of these separately we naturally begin with **Mitafifi,** or " Brown Egyptian," as this is the average quality of Egyptian, has a staple of about 1⅜ inches in length, and is famed for its regularity of length and colour. It derives its name from that of a village of the province of Galinbia, where it was evolved some thirty-five years ago from Ashmouni. It is cultivated in Lower Egypt and the Delta, and was at one time very popular because of the large yield per acre, being on average soils from 500 to 600 lb.

In the last few years it has tended to decrease ; thus in 1913 it was planted over 647,439 acres, but by the next year had fallen to 485,109, which was nevertheless the largest acreage for any variety.

Abassai is the whitest of all the Egyptian cottons and was first evolved in 1890 from Zafiri, which had been obtained from Mitafifi. The cotton is fine and silky, but has not quite the length and strength of the brown varieties. Perhaps for these reasons its cultivation has greatly declined recently.

Joanovich is considered by many to be one of the best Egyptian cottons. It was evolved by artificial selection from Mitafifi in 1897. The fibre is very strong, clean and silky and has a length of about 1½ inches. Recently spinners have shown a preference for the new variety Sakellaridis, and in consequence the acreage devoted to Joanovich has declined ; thus in 1913 it was 180,000 as compared with only 132,377 in the next year.

Ashmouni, or Upper Egyptian, is one of the oldest varieties and is the poorest in every way. It only yields about 390 lb. of lint to the acre against 500 to 600 lb. for Mitafifi. Its staple is only 1½ inches, and it is weaker, more irregular and dirtier than other varieties. Recently complaints have been made of the mixing of this variety with Mitafifi, which reduces the quality and value of the Mitafifi and produces a deteriorated seed for sowing next season. Ashmouni is used chiefly for coarse webs.

Nubari is a variety recently evolved from Mitafifi, and appears to be growing steadily in popularity despite the unfavourable opinion of some experts who compare it with Joanovich, but consider it weaker, darker, and more irregular. A fairer description would be to describe it as high grade Mitafifi of excellent staple, the fibre varying from 1·3 to 1·6 inch long and having a diameter of 0·00068 inch as compared with 0·00072 for Mitafifi. In 1914 the crop showed an increase of 63,000 acres over that planted in the previous year.

Sakellaridis was first planted on a considerable scale in 1910, since when it has steadily risen in favour with all concerned. It, like almost every other recent variety, was evolved from Mitafifi and flourishes in the same districts, which are, however, unsuitable for Joanovich, to which, moreover, it is considered superior. It is soft, silky, lustrous, cream coloured with a faintly reddish tinge, strong, 1·4 to 1·7 inches long, and has an average diameter of only 0·00062. It possesses many of the characteristics of Sea Island cotton and in addition is very productive. It is, therefore, not surprising that its acreage has increased rapidly, and in 1915 one-half of the total Egyptian cotton acreage was given over to this variety. There are already signs, however, that a new type is about to take its place.

Assili or Assil Afifi, though sometimes described as a recent variety, appears rather to be an endeavour to recover an old variety that was fast vanishing. The word Assil is Arabic for thoroughbred, and Assil Afifi therefore means pure bred Afifi cotton. It is strong and regular, and recent indications point to its becoming an important variety. In 1913 there were 68,464 acres only, but next year it had risen to 139,200. It is a Brown Egyptian similar to a superior type of Mitafifi.

The above are the only commercially important varieties, but in passing, reference must be made to the so-called

"Hindi" cotton, a kind of wild and indigenous cotton, which is still found growing wild in Abyssinia at the present time.

It is often found growing in the fields of Mitafifi and produces white, coarse inferior lint, about 1 inch long, whose presence in a bale of Mitafifi greatly reduces its value.

It can easily be recognized by the fact that the boll opens in four, or sometimes five, valves instead of in three, as does the boll of Mitafifi.

The "Hindi" seeds are also easy to recognize, as they are long and naked and bear long spikes at the pointed ends. As, however, some plants which produce ordinary brown Mitafifi cotton have long, naked spiked seeds of the Hindi type, it is evident that there has been a certain amount of cross-breeding between the wild "Hindi" and the Mitafifi.

The Tendency of Egyptian Cottons to Deteriorate

There is no doubt that Egyptian varieties tend to deteriorate rapidly. Varieties which were well known a generation ago, such as Gallini or Hamouli, are never mentioned to-day, and already varieties popular only a few years ago are giving place to new favourites.

It was Mr. Lawrence Ball who fully explained the causes for this unsatisfactory state of affairs. The gradual deterioration is due to the lack of method in cultivation, and in particular in selecting seed. Further than this, cross hybridization is constantly taking place between different types of cotton, but more particularly between the cultivated plant and the wild cotton or Hindi. Mr. Ball in his work as Government Botanist in the Department of Agriculture has proved that by breeding in accordance with Mendel's law of heredity it is possible to produce new varieties of cotton, possessing all the desirable qualities of any of the former types. These new varieties can be kept reasonably pure by careful selection, but to keep the varieties always constant it is essential that the seed should be grown in some central area under proper scientific control and distributed annually to the growers. Mr. Ball worked out such a system of distribution of good varieties, which in five years would have provided Egypt with a seed supply unequalled anywhere, but for no very obvious reason the Egyptian Government suddenly abandoned the work in 1913 just when they were about to reap the results of many years' work and experiment.

The methods of growing cotton in Egypt having already been described, it is only necessary to emphasize once more that cotton in Egypt is grown on irrigated land with fairly primitive tools by peasant proprietors, the chief implements employed being a primitive plough and a large native hoe.

Uses of Egyptian Cotton

Egyptian cotton is more suitable for certain purposes than American Upland. It is better adapted for the mercerizing process than any other cotton. Its capacity for taking dyes and its high lustre render it of great value for mixing with silk and for making fabrics with a high finish. For underclothing, curtains and embroidery the brown colour of the Mitafifi and similar types is an advantage, as the natural écru shade is preferred. Strong sewing thread is likewise produced from Egyptian cotton, and for the foundation for cycle and motor tyres it has been found the most suitable.

General Conclusions

While all is not well with the Egyptian crop, yet on the whole its position is more satisfactory than that of any other country. Although comparatively small in quantity, being produced from less than 2,000,000 acres (which during the year produce other crops as well), it is worth at least £30,000,000 and gives a sheer surplus of £20 per acre over the whole cost of production.

In view of the absolute necessity for increasing the world's supply of cotton, it is to be hoped that the Egyptian Government will do everything possible to increase the output per acre, and in particular will improve the quality of the seed and the method of distributing it to the fellah.

(B) THE REST OF BRITISH EASTERN AFRICA

THE SUDAN

The Sudan, unlike Egypt, has a considerable rainfall over a large part of its total area which extends through seventeen degrees of latitude, thus giving a great range of climate.

In the North the rainfall is insufficient and irrigation is necessary, but in the South there are large areas where the rainfall by itself is sufficient.

The principal districts in which cotton is being grown at present are as follows :—

The Tokar District.—This is about sixty miles south of Suakim in the Red Sea Province, where the Baraka River forms a Delta, and takes its name from the village of Tokar, which is situated in the centre of this Delta. As the rainfall here is inadequate the crop is dependent on the annual overflow from the Baraka. This, however, varies considerably year by year, and, moreover, much of the flood is allowed to run to waste. A scheme is under consideration whereby this surplus might be saved, and when this is carried out a considerable increase in the cultivable area should result. Transport facilities also require improving, but this could be done by the building of a railway from Tokar to Suakim or to Port Sudan.

Mitafifi is practically the only variety grown in this district on a commercial scale, but experiments have demonstrated the possibility of growing long-staple American cottons. The largest area recorded as under cultivation with cotton was 47,010 acres in 1910–11, and the total lint cotton production in that year was 5,000,000 lb. The average yield per acre is only 100 lb., but the quality is good.

The Khartoum District.—Near Khartoum and also in the Nile Valley north of that city are several areas irrigated by pumps ; of these the largest is the property of the Sudan Plantation Syndicate at Zeidab in the Berber Province. Here American and Egyptian varieties are both grown with great success.

The Gezira.—This area lies south of Khartoum between the Blue and the White Niles and consists of a plain of some four million acres, the soil of which is well adapted for cotton growing. Owing to an inadequate rainfall, irrigation is essential, and as a preliminary step, an experimental farm was established at Tayiba with a pumping installation. This experiment proved so successful that the construction of a large irrigation canal has been begun. It leaves the Blue Nile at Sennar and runs northward parallel to the river. As part of the same scheme a pumping station was established at Barakat a, short distance south of Wad Medani. The main south line of the Sudan Government Railways runs the whole length of this area. The land thus brought into cultivation has been placed under the management of the Sudan Plantation Syndicate, the owners of Zeidab. The land is let to the natives in small holdings and the Syndicate distributes seed and enforces sound methods of cultivation. The results so far have been most encouraging, the average yield per acre being as high as 500 lb. of lint. The chief varieties grown are Afifi and Nubari.

There is, therefore, every reason to believe that when the complete scheme of irrigation has been carried out a very appreciable increase in the world's cotton supply will result. There is, however, one serious hindrance to the development not only of this but of any area in the Sudan, namely shortage of labour. Before the appearance of the Khalifa the population of the Sudan is said to have been 10,000,000; after civilization was restored at the battle of Omdurman in 1898, the total left were barely 2,000,000. Under the ordered Government set up by the British the population has rapidly increased, so that by now it is estimated at well over 3,000,000; but even at this rate it will be many years before there will be enough labour to cultivate the whole area available for irrigation in the Gezira. The present scheme when complete will render 500,000 acres cultivable. At present the total population of the district is 500,000, and to cultivate this amount of land at least 1,500,000 people would be required and probably 2,500,000. As there is no surplus Sudanese population which can be persuaded to go there and the Egyptians cannot be induced to emigrate to the Sudan, this means that until the local population has vastly increased, which can hardly take place under fifteen years, the actual increase in cotton is likely to be small, although otherwise this is perhaps one of the most promising areas in the Empire.

Kassala is a somewhat similar area to Tokar, the land being watered by the flood of the river Gash. It is a fortnight's journey from the nearest railway station, as it lies on the very frontiers of Eritrea, the Italian colony on the Red Sea. There is a fair amount of irrigation carried on here, but the chief hindrance is lack of adequate transport facilities.

Rain-grown Cotton.—The possibilities for this type of cultivation in the South are undoubtedly considerable, but in the main actual attempts have been restricted to Gallabat. So far the crop has never exceeded 5,000 bales, and it would appear that American cotton is more suitable than Egyptian on account of its early maturity. Nevertheless want of labour must necessarily restrict the output here as elsewhere in the Sudan for many years, and any attempt to increase the cultivable area above the amount required by the population would only result in cut-throat competition for labour which would force up wages to such a height that they would strangle the industry.

For this reason the policy of the Sudanese Government must be to "hasten slowly" for many years.

The way in which the total Sudanese output fluctuates from year to year (due largely to the variations in the Tokar flood conditions) is shown in the following figures giving the total export of cotton in pounds :—

1901	881,600 lb.	1913	5,132,000 lb.
1908	3,967,200 ,,	1914	3,774,000 ,,
1910	6,000,000 ,,	1915	9,492,000 ,,
1911	9,129,200 ,,		

BRITISH EAST AND SOUTH AFRICA

Uganda.—Cultivation of cotton on a commercial scale only dates from 1904 when seed was introduced by the Uganda Company and by the Government. American Upland proved to be the most suitable, but unfortunately a good deal of Egyptian seed had also been introduced and the varieties became mixed. As a result the staple was very irregular and the spinners grew so loud in their complaint that the Government became seriously perturbed, and in 1908 prohibited by Special Ordinance the sowing of any seed except that provided by the Government. The variety adopted was an American Upland, known as "Black Rattler," and this was distributed to the growers, while strenuous efforts were made to eradicate all cottons of the Egyptian type. As a result a more uniform staple was produced, but the quality remained poor.

The Department of Agriculture then set to work to acclimatize a cotton of superior quality, and after several years of scientific work pure American long-stapled varieties have been substituted for the hybrid forms previously grown. In 1913–14 the whole of the main crops consisted of "Allen's Long Staple" variety.

Transport difficulties still hamper the infant industry, as much of it has to be carried on the head of natives for great distances before the nearest buying station is reached. After that it has to be ginned and then conveyed by rail and lake steamer to the terminus of the Uganda Railway.

The following figures, however, indicate that from small beginnings the industry is steadily progressing towards big things, though it will probably be many years before it will be a potent factor in the cotton markets of the world :—

Year.	Quantity.	Value.
1904	21,566 lb.*	£235
1907	1,605,184 ,,	£51,594
1910	5,538,885 ,,	£165,412
1911	8,343,813 ,,	£230,850
1913	11,191,824 ,,	£317,687
1914	13,126,587 ,,	£351,146
1915	10,520,610 ,,	£245,426

* 1904 figures are for ginned and unginned, all other years are for ginned cotton.

East African Protectorate.—Since 1904 the British Cotton Growers' Association has made strenuous efforts to promote cotton cultivation in this area. On the whole the results have not been very encouraging. European planters experimented with Egyptian varieties, chiefly near the coast, with scant success, and the natives generally prefer to grow food crops. In the Lake district of the Nyanza Province the conditions are much more favourable and the natives are beginning to plant cotton as an additional crop.

The small relative progress made is shown by the following figures, which should be compared with those given for Uganda :—

Year.	Quantity.	Value.
1904	28,880 lb.	£285
1908	251,328 ,,	£5,907
1910	163,184 ,,	£7,477
1912	295,232 ,,	£11,831
1913	134,875 ,,	£5,476
1914	17,465 ,,	£614

It should be noted that the larger quantities often obtain less than the smaller, thus 1908 and 1910 should be noted in particular.

The Former German East Africa.—Now that this area has passed under British control cotton users will naturally be speculating as to its possibilities as a cotton-producing area. Before the War experiments had proved that it was a much better cotton-growing area than British East Africa and that American varieties were most suitable for native cultivation, and while it cannot be grown successfully near the coast there are several inland districts which have proved most satisfactory.

As yet these areas are often scattered far apart, and often it is grown as a catch crop on rubber or sisal plantations while the others are maturing. The export has rapidly increased recently, figures for 1912 being 4,139,513 lb. worth £105,512, and for 1913 4,828,964 lb. worth £120,753.

It will thus be seen that there are decided possibilities in the near future for cotton users in this area, which has now passed under British rule.

NYASALAND

Cotton growing began on a commercial scale in this area in 1903, but as in Uganda American and Egyptian varieties were grown indiscriminately, with the result that a confused hybrid type developed. Now, however, these hybrid types have been sorted out and eliminated and the protectorate falls into two main cotton areas. In lands from 2,000 feet to 4,000 feet American Upland varieties are grown, while on land below 2,000 feet Egyptian cotton is cultivated. A good long-stapled American Upland has been acclimatized and is known as Nyasaland Upland, and is generally worth at Liverpool 2*d.* per lb. more than " Middling " American. In the lowlands of the Shire River Valley, Egyptian Abassi cotton gives the best result, but in the main it is American Uplands that supplies the bulk of the output. In 1913–14 25,697 acres (of which only 160 acres were devoted to Egyptian varieties) were planted with cotton by European planters. In addition to this source of supply the natives are tending more and more to grow cotton on their own. As in most other new cotton areas the development of the industry is greatly hampered by lack of adequate transport facilities. Practically the only railway is that from Blantyre to Port Herald on the Shire River, whence the cotton has to be carried on barges to the Zambesi, thence down that river to Chinde on the coast of Portuguese East Africa. At that port it is transferred to other barges which convey it to Beira, whence it is shipped to Liverpool. The new railway from Port Herald to the Zambesi will be a great help, but until the proposed new line from the Zambesi to Beira is finished, rapid development of the industry is impossible.

Nevertheless the progress made is most encouraging, as the following figures of export indicate :—

1903	56,897	lb.	worth	£1,778
1908	756,120	,,	,,	£28,355
1912	3,237,555	,,	,,	£80,939
1914	2,048,508	,,	,,	£72,068
1915	3,005,248	,,	,,	£68,586

RHODESIA AND SOUTH AFRICA

In 1910 a small subsidiary company was formed by the British Cotton Growing Association and the Chartered Company of British South Africa, but the results were unsatisfactory and the Association withdrew its support in 1912. The largest cultivation is in the neighbourhood of Fort Jameson, but transport difficulties again prevent any considerable development. In 1912 the total crop for Rhodesia was only some 2,000 bales.

In the areas now included under the Union of South Africa numerous experiments have been made and excellent samples produced, but so far nothing on a really commercial scale has been grown.

(C) BRITISH WEST AFRICA

The fact that the Lancashire Cotton Industry is mainly dependent on the United States for its raw material has been an increasing cause of anxiety to those concerned for many years. The serious disadvantage which might arise was first realized in the American Civil War (1861–4) when the supply of cotton was greatly reduced, prices rose to an unprecedented height and in consequence many mills had to close or run short time, which led to a great deal of unemployment. But what was then a temporary misfortune has now become a permanent menace, and we are fast approaching an actual world shortage. This is because the world's consumption has been increasing much more rapidly than its supply of raw cotton, owing mainly to the growth of the U.S.A. as a manufacturing country. Thus in 1880 the States consumed only 892 million lb. in her own mills, but by 1914 the annual consumption had risen to 2,830 million lb. and to 3,283 million lb. in 1918.

This economic danger was accentuated by several more or less successful efforts to corner the market in America, and in 1901 a committee was appointed to investigate the possibility of growing more cotton within the Empire and so releasing Lancashire from its dependence on the U.S.A.

The Committee in due course reported that there were numerous areas within the Empire in which cotton suitable for the Lancashire mills could be grown. As a result of this report, in June, 1902, "The British Cotton Growing Association" was formed, and at once set to work in conjunction with the various Colonial Governments to foster the growing of cotton in various areas, but especially in Africa.

Passing reference has already been made to its efforts on the East Coast in the previous chapter, but its chief success has undoubtedly been in the various colonies which together may be conveniently considered under the title of British West Africa. The example thus set by England was promptly followed by Germany, France, Portugal and Belgium, each of which has endeavoured to encourage cotton growing in suitable areas in its African Colonies.

Of these the German efforts will receive especial mention here, as that country's colonies have now been divided between England and France.

Types of Cotton grown in West Africa

Cotton is found wild throughout a large part of the West Coast of Africa, and has long been cultivated by the natives for their own use. During the American Civil War, the high prices ruling for cotton encouraged the natives, especially along the Gold Coast and near Lagos, to grow more cotton, and the merchants on their part introduced ginning and baling machinery. At the close of the Civil War prices fell and the industry in consequence declined.

Since 1903, however, the revival has continued steadily, but the climatic conditions are such as practically to exclude large European plantations, and therefore the energies of the British Association, and indeed of all the Cotton Growing Associations, have been devoted to encouraging the natives to plant more cotton and buying the surplus from them. This policy has been particularly successful in Southern Nigeria, Dahomey and Togoland.

Despite numerous attempts to introduce American varieties the indigenous native plants yield the best crops, and it would appear that the right line of development is to improve the best native varieties by seed selection and improved methods of cultivation.

NIGERIA

Nigeria falls into two natural divisions, the Southern and Northern Provinces. In Southern Nigeria, cotton has been grown by the natives for their own use for centuries. When there was a world shortage owing to the Civil War Nigeria begun to export her surplus, and in 1869 the value of the export from the Southern Provinces was £76,957, but as soon as the American plantations had recovered the export of Nigerian cotton fell, till by 1879 it amounted to only £526.

The British Cotton Growing Association have devoted more attention to this than to any other area and have achieved most excellent results. Experimental stations were established and suitable seed distributed to the natives. Buying stations and ginneries were set up and the Association agreed to buy seed-cotton from the natives at a minimum of 1*d.* per lb.

It was soon proved that the best method was to improve the indigenous cotton plant, and to do this the Association arranged that all buying centres should be under their control and that the seed-cotton was ginned in their own ginneries. A regular system of seed selection being thus established, the quality of the cotton has steadily improved, and to-day a regular grade is produced which sells at 0·1*d.* to 0·2*d.* per lb. in advance of the current price of "Middling" American cotton. This cotton is just over 1 inch in length, is rather harsh and coarse and is of a brownish tint.

On the other hand, the seed cotton gives rather a small yield of fibre, only about 27 per cent. on ginning, but as it is very strong and suffers but little waste in the manufacturing processes, these qualities largely compensate.

As large quantities of seed are produced in excess of what is required for distribution, a mill was established at Ibadan for expressing cotton oil.

As, however, there is no big local demand for the oil and cake, it has been found more profitable to export the seed itself.

The best area is the Western or Lagos Province, where the Yorubas are an industrious race who have taken up cotton growing with enthusiasm. In the Eastern Province much less is grown owing to the excessive rainfall, nevertheless the best cotton grown in West Africa comes from the Ishan District, which is in this Province. Near the coast the rainfall is too heavy and the bulk is therefore grown in the interior, north of

Ibadan. To facilitate the transport of the crops the Lagos Railway was extended from Ibadan to Jebba in the Northern Province, and later to Zungeru. Finally it was linked up at Minna with a line which had been built from Baro to Kano.

The following figures of the exports give some indication of the growth of the industry, but the big decrease in 1915 is due to conditions brought about by the War rather than to any fault of the district itself :—

1902	12,359 lb.	1911	2,238,190 lb.
1904	1,148,551 ,,	1913	6,361,120 ,,
1907	4,089,530 ,,	1914	5,649,840 ,,
1908	2,294,356 ,,	1915	2,697,072 ,,
1909	5,032,916 ,,		

The figures include cotton passing through from the Northern Province.

THE NORTHERN PROVINCE

This area not only grows a large quantity of cotton, but is the centre of quite a considerable manufacturing industry which is situated chiefly at Kano, where it has been famous for centuries, the trade with which extends over a large part of the northern portion of the continent.

Methods of cultivation vary considerably, some planting annually, while others leave the plants in for years until the crop becomes so small that it is not worth gathering, when the plantation is abandoned. In some districts cotton is grown in conjunction with yams.

The cottons mostly grown are varieties of *Gossypium peruvianum*, which give a fibre a little under an inch long. The Association has in this area endeavoured to acclimatize American varieties, and in 1914 seed of " Allen's Long Staple " was distributed to the natives. The result was, on the whole, highly successful, giving a larger yield per acre, as well as a longer staple, and was bought by the Association at 1½*d.* instead of 1*d.* per lb.

Although the opening of the line from Baro to Kano has opened up a densely populated district well suited for growing cotton, the local cotton industry also requires a considerable amount, and higher prices are often obtainable on the spot than would be justified by its value in Liverpool, and it is estimated that 70 per cent. of the total crop is used locally. It is, moreover, an open question how far the Nigerian Government would be justified in encouraging the export of cotton to the prejudice of the native industry. After all, the first duty of that Government is to the natives, to whom it stands in the position of guardian, and the destruction of an industry giving employment to thousands would be unjustifiable. This might conceivably happen if the natives were unduly tempted to export more than their surplus. Moreover, the extensions of cotton growing may be checked by the natives preferring to plant ground nuts, a crop which is increasing in popularity. For these reasons it is well not to be too sanguine, but nevertheless a large increase in cotton growing has taken place, and during the first half of 1916 the Association bought over 4,000,000 lb.; this compared with 56,986 lb. in 1908, or even with 259,280 lb. in 1912, which figures are those of the total export, indicates most satisfactory progress. Moreover, the addition of a valuable strip of cotton-growing land which was formerly part of the German Kameroons increases the importance of Nigera as a cotton-growing area.

THE GOLD COAST

The natives have, in a primitive way, cultivated cotton for their own use for centuries, but the system is quite inadequate to modern demands. It is not planted properly in rows, but grows mixed up with various food crops such as maize, yams or cassava. Generally the plants are allowed to stand for several seasons until they cease to produce enough to be worth picking. Naturally the fibre deteriorates in quality and is seldom of any commercial value after the first year.

Early attempts of the Government to encourage the growing of Egyptian and American varieties between 1890 and 1903 met with little success. The Association in 1903 began to take an active interest in this Colony, and after careful experiments came to the conclusion that Egyptian cotton was unsuitable and the American variety " Black Rattler " was the best. The

Association thereupon established a steam ginnery and buying station at Labolabo. But the natives did not take up cotton with the zeal that they did in Nigeria, and in 1910 the Association discontinued its agricultural work and concentrated on Nigeria, though it still continued to take an active part in the commercial side of the industry.

The exports were :—

1904	57,661 lb.	1911	9,701 lb.
1906	92,886 „	1913	27,497 „
1909	31,290 „	1915	12,016 „

One reason why the natives failed to take up cotton growing with enthusiasm was that cocoa cultivation came into prominence. As this crop is more profitable to the natives than cotton, they naturally preferred it, and exports of cocoa increased from 5 million lb. in 1903 to 118 million lb. in 1914. Moreover, they could provide for all their requirements from the sale of palm oil and palm kernels, the collection and preparation of which entails very little labour.

Undismayed by the failure of the Association the Agricultural Department of the Gold Coast endeavoured to develop cotton growing in the Northern territories and established a station at Tamale in 1909, but with little success, and in 1915 the attempt was abandoned.

SIERRA LEONE

In this district also the Association and the Local Government have endeavoured to develop cotton growing. Their experiments prove that while exotic varieties cannot be successfully cultivated because of the heavy rainfall, a native variety known as Quondi might be cultivated on a large scale. It has a fibre of a pale cream colour about an inch long, but any development on a commercial scale seems unlikely, as the natives are disinclined to undertake the amount of labour necessary and are able to live on the forest products such as rubber or palm oil.

The largest amount ever exported was 68,808 lb., in 1905. Since 1909 the exports have been nil.

GAMBIA

Though the natives have long grown cotton for their own use, attempts to build up an export trade have completely failed owing to reasons very similar to those which caused a like failure in Sierra Leone. Briefly it pays better and entails less trouble to grow ground nuts than cotton.

In short, therefore, we may say that while the efforts of the Association have been most successful in Nigeria, everywhere else they have resulted in failure. Quite wisely, therefore, it has decided to concentrate attention on Nigeria for the time being.

One other area remains for consideration, and that is Togoland, parts of which go to Great Britain.

TOGOLAND AND THE KAMEROONS

After Great Britain, Germany did more to develop cotton growing in East and West Africa than any other country, although France, Belgium and Portugal have all in recent years endeavoured to foster the cultivation of cotton in their African Colonies. Nevertheless the British Colonies in East and West Africa produced double the quantity of cotton that the Colonies of all the other four States produced.

The Germans possessed four areas in Africa: Togoland, the Kameroons, and German South-West Africa on the West Coast and German East Africa on the other side of the continent. Enough has already been written about the latter colony in the last chapter, but a certain amount of attention must be devoted to the three remaining areas which in part or in their entirety have now passed within the British Empire.

It was in Togoland that the greatest progress had been made, and the Germans, like ourselves, had developed cotton cultivation by encouraging the natives to grow cotton, the varieties most satisfactory being native ones. Special interest attaches to the experiments made by them with a tree cotton, known as Caravonica cotton. In the British Colonies this variety was not considered satisfactory, and despite the laborious efforts of the Germans it cannot truly be said that they have been really successful in their attempts with it. Certain American varieties have proved fairly successful, as also have several Indian cottons.

In 1913 the total production of Togoland was, however, only 2,220 bales of 550 lb. each. This comparatively small return for all the efforts expended by the German Government was owing to the fact that palm oil, as in several of our own colonies, proves a more attractive crop to the natives.

Togoland was probably better served with railways and roads than any other part of West Africa, and all the lines pay well. Indeed Mr. Arthur Hutton, President of the British Cotton Growing Association, once said, quite truly, it was impossible to build a railway in Africa that will not pay.

Here if anywhere, then, conditions appear favourable for the development of a large cotton-growing industry, but the fact that the natives prefer other crops all over this district, except in Nigeria, should make cotton enthusiasts cautious in prophesying any considerable increase in the export of cotton from the West Coast, with the solitary exception of Nigeria.

In the Kameroons little has been done owing to lack of railways, but undoubtedly there are large areas suitable for the crops, and a considerable part of them lie within the district which has passed to Great Britain, namely the North-Western area near Lake Chad.

The population here is fairly similar to those in Northern Nigeria, and in view of the success which has attended the efforts of the British Association in Nigeria, we are justified in hoping for a considerable development of the industry here once it is linked up by rail with the railway system of Nigeria.

German South-West Africa need not detain us long, for as yet very little cotton has been grown there ; nevertheless in the Northern portion some exceptionally fine cotton has been grown, almost equal it is said to Sea Island cotton.

This colony was fairly well supplied with railways, but the ferocious policy adopted by the Germans towards the unfortunate natives has brought its own punishment. In short, the native population has been so reduced that unless natives can be induced by the British Government to emigrate from our older colonies into this new British possession, it will be many years before any appreciable quantity of cotton can be exported from this area.

Before closing this chapter it may be well to put on record the fact that the total production of cotton from the whole of Africa in 1913 was only 35,000,000 lb. This figure excludes Egypt, but includes the Anglo-Egyptian Soudan and all the colonial possessions of all the European states, as well as those areas which have been specifically mentioned.

This will cause super-optimists to pause and realize that it will be many years before the Black Continent can render Europe independent of America. On the other hand pessimists should remember that the various Cotton Growing Associations had only been at work some ten years, and most of their early work was purely experimental. In Nigeria, at least, Great Britain has discovered a good cotton area.

Indeed most of Africa, it has been proved, could grow cotton, but two things are essential: firstly, railways must be built, and secondly, and this appears more difficult, the growing of cotton must be made more attractive to the natives than palm-kernels or other similar crops.

Unless this is done, no building of railways or distribution of good seed will have any appreciable effect on the output of cotton from Africa.

(D) INDIA

India in 1917 supplied 16·5 per cent. of the total production of cotton in the world, and if any considerable increase in the Empire's supply of cotton is to be expected in the near future, India is the most likely source. Cotton has been grown in India at least as far back as 800 B.C., and although it is now so far behind the United States in the volume and quantity of its cotton crop, there is no inherent reason why the position could not be materially improved in the immediate future. At present the quality of cotton produced is distinctly low grade, yet yarns as high as 300's are recorded, and the fine muslin of Dacca has become traditional. The acreage under cultivation in 1913 was 25,020,000, producing a total of 4,052,000 bales of 500 lb. each, or an average of only 81 lb. per acre. Table I. shows the fluctuations from 1907 to 1917 in area and output, and it cannot truly be said that they show any marked increase either in acreage or average production per acre. If we compare this low output with the modest 200 in the United States or the excellent 450/500 lb. in Egypt, we shall see at once that here alone it would be possible, with a little care in cultivation, to double the output without increasing the total land devoted to the crop, and experts declare that under the best conditions Indian cotton land will easily produce 1,000 lb. per acre.

The quality is equally unsatisfactory. It is largely under ½ an inch in length, and its condition when marketed, mixed with dirt, leaves and trash, reduces its value.

Causes

For the most part the native cultivator not only takes no trouble to select the best seeds for planting, but actually sells the best for crushing, keeping only the rubbish for his next planting. The methods of sowing and cultivation are careless in the extreme, while the lint and seed are badly packed and carelessly handled afterwards. Indeed Surat cotton has

TABLE I.

COTTON PRODUCTION.

Year.	Acreage planted in Cotton.	Total (500-pound bales).	Average per acre (lb.).
1907	21,630,000	2,497,600	58
1908	19,999,000	2,952,800	73
1909	20,545,000	3,774,400	92
1910	22,596,000	3,082,400	68
1911	21,615,000	2,630,400	59
1912	22,028,000	3,688,000	84
1913	25,020,000	4,052,000	81
1914	24,595,000	4,167,200	85
1915	17,746,000	2,990,400	84
1916	21,745,000	3,601,600	83
1917	24,781,000	3,228,800	65

earned a reputation for being the worst cotton for spinning purposes.

The dangerous shortage of the world's cotton supply has, however, caused active steps to be taken in India to alter this state of affairs, and the Report of the Indian Cotton Committee, published in 1919, is just to hand. This is a large folio publication of over 200 pages, replete with maps, charts and diagrams, and those particularly interested in Indian cotton would be well advised to obtain a copy. Obviously it is impossible to give their Report in detail, but a few extracts from their conclusions are included in their proper place. It is believed that if proper measures were adopted, the Indian crop would be doubled in five years, and already, in 1914, India was producing at least 300,000 bales of cotton of 1-inch staple per annum. At the present time the bulk of the cotton produced in India is sold to Japan or is used in the Indian factories, or, in pre-war days, went to Germany and was utilized for the production of coarse materials made of short staple cotton. The varieties vary from 0·5 inch to 1 inch and the average diameter is 0·00084 inch.

Indian Varieties

The cottons grown may be classified into early and late varieties, the former being sown from March to June and requiring five or six months to mature. These include Bengals, Oomras and Hinganghat. They are grown on light soils and usually as mixed crops. The later crops are sown from June to October and yield in about eight or nine months. They include Dholleras, Broach, Coomptas, Westerns, Dharwars, Tinnevellys and Cocanadas. They are usually grown on deep, black, loamy soil and produce crops of more uniform character and more definite races of the cotton plants than the earlier varieties.

Bengals.—These are grown mainly in Rajputana, Punjab, the United Provinces and in parts of Central India. They are the shortest and coarsest varieties grown in India and are often badly stained, the fibre is harsh, rather weak and about $\frac{1}{2}$ to $\frac{3}{8}$ of an inch long.

Oomras.—This variety takes its name from the town of

Oomraoti or Amraoti in Berar, and is principally grown in Berar and in the Khandesh, Barsi and Armednagar districts of the Bombay Presidency. Oomras proper is a wide, soft, strong cotton $\frac{3}{4}$ to $\frac{7}{8}$ of an inch long, but is usually spoilt by being contaminated with fragments of broken capsules. Belati, which is a variety of the last kind, is white, rather harsh and shorter than the Oomras proper.

Khandesh is really a mixture of at least three varieties of the above and is naturally of an irregular length, with an average of $\frac{5}{8}$ to $\frac{3}{4}$ of an inch. It is inferior to Oomras proper, but, like it, very leafy. Barsi and Nagar cottons are good staples, but similarly spoilt by large quantities of broken capsules.

Hinganghat or Bani was a superior cotton grown in the Valley of the Wardha in the Central Provinces; but it has considerably deteriorated and recently has tended to be replaced by a mixture of varieties known as "Jari," which yields a short, coarse lint. The reason for the substitution of "Jari" is that it ripens earlier than the Bani variety and is hardier and less liable to disease and injury from rain. Hinganghat cotton is a lustrous, white, strong cotton with a length of about one inch.

Dholleras.—This variety is grown chiefly in the native States of Kathiawar and, to a lesser extent, in parts of Northern Gujerat, in Cambay and Baroda. It is a fine, soft, fairly strong cotton about $\frac{7}{8}$ to 1 inch long, but usually dirty and leafy, and in recent years its quality has been impoverished by the admixture of short staple varieties.

Broach is the best and finest of the indigenous cottons of India and is found only in the Southern Gujerat Provinces of the Bombay Presidency. It is a good colour, soft, silky, fine and lustrous, and is about $\frac{7}{8}$ to 1 inch. It rather resembles American Upland cottons, but, like so many other Indian varieties, has degenerated in recent years.

Coomptas.—This cotton is grown in the Dharwar district. It is soft, fine and strong and about 1 inch long, but is darker in colour and less lustrous than Broach and is generally dirty.

Dharwars.—This is believed to be an American variety, originally derived from New Orleans seed which has become acclimatized. At one time of excellent quality, it has undergone considerable deterioration, but is still one of the best grades. Saw-ginned Dharwar is of good white colour, fine, soft, silky and strong, and is about $\frac{3}{4}$ to 1 inch long.

Westerns.—These are grown mainly in the Madras Presidency and to a lesser extent in parts of the Bombay Presidency and the Nizam's Territory. They are strong, coarse staples, $\frac{3}{4}$ to $\frac{7}{8}$ of an inch in length, dirty and leafy. Westerns proper are fairly white, but dull and rough. Northerns, which come from Cuddapah and Kurnul, are more silky than Westerns, but have a slightly reddish tinge.

Tinnevelly.—This variety is grown in Tinnevelly, Trichinopoly, Madura, Tanjore and South Arcot. It is very white, fine, soft and strong, has a silky lustre and is clean. It is used by English manufacturers for spinning in conjunction with American cotton, and is one of the few Indian cottons suitable for that purpose.

Coconadas.—This grade comes chiefly from the Kistna district of the Madras Presidency and, to a lesser extent, from the Godaveri and the Nellore districts. It is fairly long, strong and silky, and has a reddish brown tint, and is used for the manufacture of lace and dyed goods.

Coimbatores or Salems are an exoteric variety derived from Bourbon seed, which is grown in the East of Coimbatore, Madras Presidency. It was at one time of excellent quality, but has much deteriorated and is now very coarse, poor, short, rough and weak. It is largely used for adulterating superior Tinnevelly cotton.

The Western part of the Punjab, which contains 80 per cent. of the cotton-growing area of that province, is practically rainless, but great irrigation works are in progress which will further increase the area available for cotton growing. Various schemes for irrigation are in hand, although they have been checked by the War, among which reference should be made to a scheme for developing some 7,500 acres on the Lower Bari Doab Canal, for the purpose of running a modern plantation on a large scale.

In addition to these well-known varieties, perennial or tree cottons are also grown in many parts of India, such as at Rozi in Northern Gujerat. The general feeling, however, is that tree cottons should be abandoned, as they harbour insect pests and their total output is comparatively small.

BURMA

In Burma three distinct classes of cotton are grown :—

1. **Shan Cotton,** which is about 1 inch in length and is grown on the hills of the Shan and Chin States, East and West of the Irawaddi. A sub-variety, known as Wa-gyi or late cotton, is also grown on the hills near Prome, farther South, which has a staple of $\frac{5}{8}$ to 1 inch in length. The ginning outturn of these two is high, being nearly 40 per cent.

2. **Wa-gale,** which is about the same length as Wa-gyi, and is grown in the dry zone between the Chindwin and the Irawaddi Rivers. A sub-variety, known as Bhamo, if properly handled, might be as good as the best Surtee Broach, but there is also an inferior variety of Red Khaki cotton which is mixed in with these two varieties and spoils the general output.

3. There are also two varieties of tree cotton, the one known as Nanking with a staple of $\frac{7}{8}$ to 1 inch, and a Brazilian tree cotton known as Thinaw-wa, which has a staple of $1\frac{1}{2}$ inches, is silky and fairly strong, and is grown near Moulmain.

There appears to be no question that the output of cotton could be very easily increased in Burma. The principal difficulty is that the Burman will not grow cotton on land suitable for rice. As, owing to climatic conditions, the most satisfactory method appears to be the growing of it on irrigated lands, experts are of the opinion that better qualities than those of the native varieties would have to be planted to justify the use of irrigated land which would otherwise be devoted to rice. The Government has had some successful experiments with Cambodia cotton, which is really a variety of American long staple, and individuals interested in cotton growing would be well advised to study carefully the prospects in Burma.

Ginning in India

There is very little uniformity in the methods employed in ginning, baling and pressing in India. In most parts the ginners buy the seed cotton for ginning, but in the South, ginners, who are also the exporters, buy the lint after ginning.

In Southern India the bale is 500 lb. and is well pressed, the exact density varying according to the intended destination of the bales, those for Europe being the most heavily pressed. The roller gin is still used in most parts of India, but for Dharwar American cotton these have been replaced by the American saw gin, which is much faster and gives fully 30 per cent. more output. In most of the important cotton-growing centres the European export houses have their own ginneries, but in the Punjab the ginneries belong entirely to native firms who buy the seed cotton from the " bania " or local moneylender and whose speculation in cotton often results in depriving the grower of much of his rightful due. In most districts the ginneries are somewhat primitive and such labour-saving devices as automatic cotton conveyors are unknown.

In Surat, however, most of the ginneries are in the hands of well-to-do firms, and many of the Bombay exporters are interested in them. It is due to lack of adequate supervision in the ginneries that so much of the cotton gets mixed up, so that the original varieties are almost destroyed. Damping, or deliberate watering, of the ginned cotton, and in some districts of unginned cotton, so as to increase the weight, is a frequent trick. By far the largest proportion of the Indian crop goes to Bombay, where it is left on the cotton green entirely unprotected from the weather and exposed to the serious risks of fire. The statistical returns from India are far from satisfactory, and one of the most practical suggestions made by the recent Commission in their 1919 Report is for a substantial improvement in the methods of collecting the returns.

Indian Consumption of Cotton

It is exceedingly difficult to estimate exactly the total amount of cotton consumed locally, as much of it is still made up on hand looms in villages, but since 1900 the number of cotton spindles in India has increased from 4,945,000 to 6,500,000. The exact quantity in bales has been variously estimated at 500,000 to 1,000,000 bales per annum.

The following table (Table II.), which is compiled by Professor Todd for the Report of the Indian Cotton Committee,

TABLE II.

Season.	Acreage.	Per cent. on 1913.	Crop.	Yield per Acre.		Liverpool Prices (Pence per lb.)		
						Lowest.	Highest.	Average.
AMERICAN	Acres		Bales—500 lb. approx.	Bales	lb.		Middling	
1913–14 . .	37,458,000	—	14,609,968	·39	195	6·20	7·96	7·26
1914–15 . .	37,406,000	100	15,067,247	·40	200	4·25	6·50	5·22
1915–16 . .	32,107,000	86	12,953,450	·40	200	5·34	8·74	7·51
1916–17 . .	36,052,000	96	12,976,000	·36	180	8·12	19·45	12·33
1917–18 . .	34,925,000	93	12,000,000*	·34*	170	16·90	24·95	21·68
1918–19 . .	37,073,000	99	12,500,000*	·34*	170	—	—	—
INDIAN			Bales—400 lb.				No. 1 Fine Oomra	
1913–14 . .	25,020,000	—	5,065,000		81	4·70	6·56	5·87
1914–15 . .	24,595,000	98	5,209,000		85	3·94	5·00	4·46
1915–16 . .	17,746,000	71	3,738,000		84	4·75	6·90	6·09
1916–17 . .	21,745,000	87	4,502,000		83	7·10	18·30	11·00
1917–18 . .	24,781,000	99	4,036,000		65	15·50	20·36	16·60
EGYPTIAN	Feddans		Kantars				F. G. F. Brown	
1913–14 . .	1,723,094	—	7,684,172		444	8·15	10·45	9·44
1914–15 . .	1,755,270	102	6,490,221		369	6·30	8·30	7·34
1915–16 . .	1,186,004	69	4,806,331		406	7·50	11·90	10·42
1916–17 . .	1,655,512	96	5,111,080		310	11·60	31·50	21·56
1917–18 . .	1,677,310	97	6,250,000*		375*	27·50	32·80†	30·97†
1918–19 . .	1,315,572	76	4,930,000*		375*	—	—	—

* These figures are estimates.

† Sakel.

shows the acreage, yield and prices of the world's chief cotton crops in 1913 to 1919.

From this it will be seen that the average Indian yield in 1913 was 81 lb. per acre, and the price 6·56 pence per lb. Despite the heavy increase in the average price given for fine Oomra, in 1917–18, namely 16·6, the yield per acre had fallen to 65 lb.

(E) OTHER BRITISH AREAS

(1) THE WEST INDIES AND SEA ISLAND COTTON GENERALLY

Sea Island cotton is practically confined to two areas, the West Indies and the Atlantic States (Florida, Georgia and South Carolina). It is quite a different variety of cotton from the American Upland, and its origin seems to have been in the West Indies. Its scientific name is *Gossypium barbadense.* It is believed to have been brought to Charleston in 1786 via the Bahamas, and the best quality is still obtained from the islands near Charleston. Sea Island cotton never grows as well inland as near the sea, and the crop of Florida and Georgia is in consequence only a second grade Sea Island cotton. The total quantity of the whole crop is small, about 100,000 bales of 400 lb. each, and fluctuates annually, and indeed in 1912 the crop only amounted to 68,160 bales. The Carolina Islands produce 11–12,000 bales, of which 4,000 are first-class quality and the others not quite as good. Georgia produces some 45,000 bales and Florida about 40,000 bales. Unfortunately the price fluctuates considerably, owing partly to the fluctuating quantity of the crop and also to the specialized nature of the demand, as it is principally used in the lace trade. In recent years the best grades of Egyptian cotton, such as *Sakel,* have tended to compete with it. The peculiar advantage of Sea Island cotton is its great fineness and length. The great damage done by the boll weevil has still further discouraged the growers, as Sea Island cotton suffers especially severely from this pest, as it is a late maturing variety, the latest of all. The damage caused by this animal to late maturing varieties is always particularly severe, and the latest reports show that it has been almost destroyed.

The West Indies

The only other source of supply outside the States is the West Indies, which are, to a certain extent, safeguarded from the ravages of the boll weevil by intervening water. The total crop here is, however, very small. In 1908 there were only 7,500 bales, and of this only 1,500 were really first grade quality. The principal source of supply was St. Vincent, Barbados and St. Kitts. Of second grade Sea Island cotton there were about 4,000 bales, and the remaining 2,000 odd bales were about equal to Florida Sea Island. In addition to these there is a lower grade cotton known as *Marie Galante*, amounting to about 1,000 bales, which is believed by some to be a wild native cotton perhaps related to the true Sea Island. It is possible also that the Hayti crop, which, owing to the bad methods of cultivation, is at present of comparatively small value, may be improved now that America has taken that country in hand. During the War the increased value of sugar has rather tended to divert the attention of the local cultivators from cotton to the sugar cane, despite the demand for all types of cotton, but it nevertheless seems desirable to encourage the growing of more cotton, not only of the Sea Island variety but also of other grades in this portion of the British Empire. Considering the West Indies from this point of view, we will proceed to tabulate briefly their potential cotton-growing possibilities.

Trinidad, which is the largest, does not seem a very suitable area, as the air is too damp to suit the plant, and other crops have been found more profitable.

Tobago has a better climate, but about half the area is more suitable for cocoa than cotton. Tobago has taken up cotton growing fairly recently, although in 1780 it produced more than 2½ million lb., or nearly as much as the whole present crop of the West Indies. Experiments with Sea Island cotton appear to have been a failure, but a hybrid cotton produced by crossing Sea Island with *Marie Galente* gave fair prospects, but little progress has been made in recent years.

Grenada has similarly largely replaced cotton by cocoa, but *Marie Galente* is still grown, and the average output yearly is about 1,000 bales.

St. Vincent produces the best quality of Sea Island cotton grown in the West Indies, yet the first attempt to grow the crop was only made in 1904. The average yield is about 145 lb. per acre, but it appears to be tending to diminish, probably owing to faulty methods of cultivation. As in most of the West Indies, there is not an adequate labour supply. Nevertheless, wages are low (about 1*s.* per day)—about a quarter of what they are in America—and probably a small increase in these rates will be sufficient to attract the surplus of labour which is being released by the completion of the Panama Canal, which for many years has attracted most of the available surplus labour supply. The fact that nearly £100,000 of wages earned annually in the Canal zone was being remitted to Barbados, indicates that a large part of the indigenous labour supply of the West Indies has been diverted to that area, and on the completion of the work the majority of the labourers will probably return to their homes, but it is unlikely that they would be prepared again to work at the old low rates. In St. Vincent the area under cotton averages about 5,000 acres.

Barbados, which was once the chief producer of cotton in the West Indies since 1908, has fallen to second place, her former position having passed to St. Vincent. The average yield per acre seems to be decreasing. In 1908 127 lb. was considered an exceptionally high yield, but just before the War barely 100 lb. per acre was obtained. Here, again, bad methods of cultivation and a deteriorating seed supply are the probable causes of the decline, and these defects must be remedied if cotton is to become a sufficiently remunerative crop to compete successfully with other local products.

St. Lucia is also capable of producing Sea Island cotton, but the supply has decreased almost to vanishing point, largely owing to the insufficiency of the labour supply, the natives in recent years tending to emigrate to the goldfields of French Guinea and to the Panama Canal.

In **Guadeloupe,** which belongs to the French, the French Colonial Association has made great efforts to encourage cotton cultivation, but with very small success.

The Leeward Islands

The Leeward Islands produce nearly half the total West Indian Sea Island crop, and the principal source is Montserrat, which comes third in the list of the West Indies as a source of cotton. It would appear as if, with a little judicious encouragement, considerably more could be grown in Montserrat than at present, as the natives recognize that it is a remunerative crop, although they are somewhat lazy and disinclined to devote the large amount of labour which it entails.

St. Kitts-Nevis and **Anguilla** are now under one Government and produce annually about 1,500 bales. St. Kitts is particularly fertile, but as cotton is usually grown as a catch-crop in rotation with sugar and the interval between the two sugar crops is seldom more than nine months, the cotton is often pulled up before the whole of the crop is ripe. Nevertheless as much as 300 lb. of lint per acre is said to be possible. The finest St. Kitts and Antigua cotton is better than any other cotton in the West Indies, except some of the very first-class cotton grown in St. Vincent. In Nevis about 1,000 bales of cotton is said to be produced of varying qualities. Anguilla has been redeemed from abject poverty almost entirely through cotton, and cotton growing on a small scale has been most successful. With further encouragement these last three islands will probably double or treble their crop.

Antigua grows cotton as a rotation crop with sugar and the quality is good. Despite somewhat unfavourable climatic conditions (droughts are frequent) there seems every reason to believe that Antigua and the neighbouring island of Barbuda may in the next few years considerably increase their output.

In the **Virgin Islands** cotton growing is entirely carried on by peasants and small growers, and the Government has taken a paternal interest in the industry, buying from them the seed cotton and undertaking the ginning, grading and exporting and also the selection of the seed for the next year. Owing to this excellent system the industry has developed rapidly, the principal quantity produced being of the *Marie Galente* type. In the American Virgin Islands of St. Croix, etc., large tracts, formerly under sugar, have been put under cotton, the product of which is said to be equal to that of Anguilla in quality.

Of the non-British West Indies mention may be made of the Dutch Islands of St. Martin and St. Eustatius, where the British Cotton Growing Association has taken a considerable interest in the development of the crop. Sea Island cotton of good quality is grown, some being nearly equal to that of St. Kitts, and further development seems possible.

Although the total production of Sea Island cotton in the **Greater Antilles** is not large, there is a considerable production of inferior cotton. This is particularly so with Porto Rico, where a small amount of Sea Island cotton and a certain amount of other cotton is annually produced, all of which, however, goes to the United States.

The two Republics of **Hayti** and **San Domingo** have for years past been in a chronic state of misgovernment. During the War America took charge of both, and although they are still nominally independent and self-governing, in practice the United States has established a protectorate over them, and there is every reason to believe that just as they turned Cuba from a poverty-stricken and discontented country into a prosperous State, so in due course they may do the same good offices for these two negro Republics. The cotton grown in both is of a low grade, indigenous to the island. The quantity produced in Hayti alone is at least 10,000 bales, but no reliable statistics are available, and it is quite possible that it is considerably more. The staple is said to be long, but the quality is poor and the cotton badly prepared and packed, with the natural result that its price is low, and at present it cannot be reckoned as true Sea Island cotton. It is quite possible, however, that with improved methods of preparation it may before long rank, at any rate, as a second grade Sea Island type. In pre-war days it ranked with best Brazilian and in 1912 fetched about 10*d*. per lb. In Cuba attempts are being made to grow Sea Island cotton, but so far the competition of sugar has been too strong, and moreover the crop has suffered from the boll weevil, which has discouraged local growers.

In **Jamaica** a certain amount of progress has also been made, but hitherto sugar and bananas appeared the more attractive crop, with the natural result that although the country seems suitable, no great progress has been made.

In the **Bahamas** the production of cotton on a commercial basis is almost negligible, and although it is possible that more could be produced, there does not at present appear to be any great likelihood of any considerable change.

The principal pests in the West Indies are the cotton worm, the leaf-blister mite, the flower-bud maggot and cotton aphis. The Sea Island cotton is an exceedingly tender plant and readily attacked by insect pests which do not do much damage to the wild varieties.

The flower-bud maggot seems to be confined to Antigua and Montserrat, where it does considerable damage, and the leaf-blister mite seems to be peculiar to the West Indies.

Ginning

Most of the ginneries in the West Indies are privately owned, though a few were erected with the assistance of the British Cotton Growers' Association. Except in St. Vincent the cotton is pressed by hand or power presses into bales, but in St. Vincent the best grades are exported in unpressed bags so as to avoid any possible risk of injuring the fibre by pressure. The weight of the bales varies from 250 to 500 lb., but for statistical purposes the average is taken at 400 lb.

Statistics

The Sea Island crop from America in 1913 was 82,277 bales of 400 lb. The totals from the West Indies, including all varieties, were in 1913 as follows :—The Leeward Islands, 3,060 ; and the total from all the British West Indies, 6,592 bales of 400 lb. The equivalent in 500 bales from British West Indies was 5,274, and with that from the foreign West Indies about 6,145 bales. This does not include the Hayti and San Domingo crop, for which no reliable statistics are available, and cannot be reckoned as at all of the nature of Sea Island. This total of 6,145 bales of 500 lb. represents all that can possibly be described as Sea Island cotton obtained from the total West Indies, and some of this is distinctly second rate in quality if it can be truly reckoned as Sea Island at all.

The Demand for Sea Island

The demand for this variety of cotton, though limited, has not yet been reached, and in view of all the facts of the case it is more than likely that the users of the Sea Island variety will be obliged to use Egyptian *Sakel* in place of the lower grades. It is doubtful whether the West Indies can supply a crop of the highest grade equal in amount to that obtained from the Carolina Islands, and in view of the depredations of the boll weevil, the situation for the lace and other industries which require higher grade Sea Island is undoubtedly serious. The only other possible sources of supply are Egypt and possibly the new fine cotton districts which are developing in Arizona and California.

(2) BRITISH OCEANIA, ETC.

Not a great deal of cotton is produced in British Oceania. In New Guinea, which is shared between the Dutch, British, and in former days Germans, only slight attempts have been made, except in the German area. Some fine samples described as real Sea Island staple were produced in 1906 in the German portion, and these fetched a high price, but despite this an irregular rainfall and labour difficulties render permanent success on a large scale unlikely, and similar attempts in British New Guinea in 1905 led to equally negligible results.

Queensland

In 1913 the Department of Agriculture, in conjunction with the British Cotton Growing Association, began a system of distributing seed gratis, guaranteeing the growers a fixed minimum price of 1½*d.* per lb. of seed cotton, with a further payment if the price actually realized was more than sufficient to cover the cost of ginning, baling and shipping the cotton to Europe, and the original advance. Despite the strong attractions of sugar, there appears to be considerable prospects of this new area increasing in importance. There are large tracts both in Queensland and in the Northern Territories of South Australia which are suitable for cotton growing, and many of the districts have sufficient rail communications to the coastal ports. The principal difficulty is, of course, labour, more particularly in view of the hostility of the Australians to importing native labour, and the high rates demanded by Europeans. Neither does it seem likely that the native bushmen are sufficiently civilized to make satisfactory cultivators, and these are the sole source of cheap labour available. Several varieties of cotton have been tried, including Sea Island, which appears to do well in the northern portion of Queensland. West of Brisbane Upland seems the most suitable variety, while in Central and Southern Queensland, long-staple American is better. If irrigation were introduced, Egyptian cotton could be grown, but so far nothing has been attempted. Good yields, as much as 200 lb. of seed cotton per acre, are said to have been obtained, but the heavy cost of transport to England is a serious handicap, especially with those cottons which are of low value.

Fiji

At one time cotton was the second largest export of Fiji, and in 1880 the crop was valued at £30,000. Since that date cotton cultivation has decreased owing to the natives preferring more profitable crops such as copra, sugar and fruit. Since 1906, experiments have been recommenced at the Lautoka Experimental Farms. Recently the small Indian settlers have begun to turn to cotton growing, and it is possible that these men may make a success of the industry. The cotton grown is chiefly Sea Island of good quality, which being a highly valuable crop, repays transporting to Europe.

With the exception of the sporadic growing of cotton in a few other Islands from time to time, this is the sum total of the cotton produced or producible in British Oceania.

Cyprus

A brief reference should perhaps be made to Cyprus. The cotton grown is chiefly a native type with a short, coarse fibre, but a certain amount of American Upland is also produced. In 1913 some 4,614,999 lb. were produced, of which 1,505,728 were exported, worth £40,693. In 1915 some 700,112 lb. were exported.

A little cotton is also grown in Malta.

CHAPTER IV

COTTON GROWN OUTSIDE THE EMPIRE

(A) COTTON IN THE UNITED STATES

THE American cotton crop supplies more than half the world's cotton consumption, and the price of American Middling acts as the basis of all the varieties of cotton throughout the world. The area of the American cotton belt is about 700,000 square miles or 5½ times the total area of Great Britain and Ireland, but not more than one-tenth is under cotton cultivation, in 1913 some 37,089,000 out of 450,000,000 acres being devoted to cotton, and in 1918 the total area was 37,000,073. In the intervening period there had been a considerable reduction in the amount of acreage devoted to cotton, the lowest being in 1915, when only 31,412,000 was used for this crop.

Table I. which follows shows the amount of acreage, with the number of bales produced, from 1913 to 1918, and the second table shows the division of this acreage among the various States. From these figures it will be seen that Texas is by far the largest cotton-producing estate ; that Georgia, which is second, produces only half as much ; while Mississippi in 1918 was third, a position she has not always held, as Alabama has generally in the past occupied that place.

TABLE I.

Growth Year.	United States.
1918—Acres	37,073,000
1917—Acres	33,841,000
Bales	11,248,242
1916—Acres	34,985,000
Bales	11,363,915
1915—Acres	31,412,000
Bales	11,068,173
1914—Acres	36,832,000
Bales	15,905,840
1913—Acres	37,089,000
Bales	13,982,811

TABLE II.

Growth Year.	United States.
1918—Acres	37,073,000
1917—Acres	33,841,000
Bales	11,248,242

	Alabama.	Arkansas.	Florida.	Georgia.	Louisiana.	
1918	2,622,000	2,922,000	167,000	5,432,000	1,553,000	acres
1917	1,977,000	2,740,000	183,000	5,195,000	1,454,000	,,
	520,906	953,587	48,178	1,885,054	629,719	bales

	Mississippi.	Missouri.	N. Carolina.	Oklahoma.	
1918	3,264,000	461,000	1,609,000	3,161,000	acres
1917	2,788,000	345,000	1,515,000	2,783,000	,,
	886,269	144,709	656,656	955,342	bales

	S. Carolina.	Tennessee.	Texas.	Virginia.	
1918	2,995,000	926,000	11,910,000	51,000	acres
1917	2,837,000	882,000	11,092,000	50,000	,,
	1,267,135	238,806	3,041,726	20,155	bales

THE ATLANTIC STATES

The belt falls into three main areas. The first includes North and South Carolina, Georgia and Florida, although the latter State is usually considered as belonging to the Gulf area geographically, but its crop, which is mainly Sea Island, may be more readily classed with that of Georgia and South Carolina. The principal ports are Norfolk (Virginia), Wilmington (North Carolina), Charleston, the centre of the Sea Island crop, in South Carolina, Brunswick and Savannah in Georgia, Jacksonville in Florida. The types of cotton grown in this area vary considerably, starting with a high-class Sea Island cotton grown round Charleston and descending to a very low grade Upland cotton produced in parts of Georgia and the Carolinas.

THE GULF STATES

The above States, namely Texas, Louisiana, Mississippi and Alabama, together supply nearly one-third of the total American cotton crop, and the chief Gulf ports are Galveston, New Orleans, Mobile and Pensacola (in Florida). Of these, New Orleans is unquestionably of the greatest importance, as, in addition to its position as export centre, it possesses the only cotton-futures market outside New York. In quantity of actual exports, however, it has been surpassed by Galveston, through which the bulk of the Texas crop passes. Texas, although included in the Gulf area, might more properly be grouped with New Mexico, Oklahoma and the Western part of Arkansas as a separate section of the Belt.

The importance of Texas is due to the redistribution of the cotton crop, caused by the destruction wrought by the boll weevil. Whereas formerly the Southern parts of Mississippi and Alabama and the State of Louisiana showed the densest production of cotton, these districts hardly produce half their former quantity.

THE CENTRAL STATES

The Central States have now become the source of supply of the finer qualities, the most important sections being the river areas in the States of Mississippi, Tennessee and Arkansas, the most valuable area of all being the large triangular area known as the Delta, lying between the Mississippi and the Yazoo rivers, where the latter joins the former at Vicksburg, some 240 miles above New Orleans.

In addition to these areas, where cotton is for the most part rain grown, there are two irrigated districts, one in the Salt River Valley in Arizona and the other in the Imperial Valley, California. These areas are of particular importance because of the far higher percentage of cotton produced per acre. The average yield per acre in America is comparatively low, particularly when compared with Egypt, where 500 lb. per acre is by no means out of the way.

The reasons for this are varied, but the principal one would appear to be lack of enough efficient labour. An important subsidiary cause is the disinclination of the planters to select their seed properly. In the last two areas mentioned the ability of the planter to control the water supply has led to a general endeavour to improve the methods of cultivation, and although much still requires to be done, it is an encouraging fact that in Arizona the average output is 285 lb. and in California 242 lb. per acre for the year 1917. Compare these figures with the average yield per acre in the same year with

Louisiana, where it was 210, or Missouri, where it was only 190 lb.

Climatic Conditions

With the exception of Arizona and California, no considerable quantity of cotton is grown under irrigation in the United States, and the crop is therefore largely dependent on the natural rainfall. On the Atlantic shore the rainfall is heavy and the atmosphere humid, and therefore the ridges in the fields are made in curves to prevent a straight rush of water sweeping everything before it. In the Central States the river and its tributaries provide ample moisture and, unfortunately, at times serious floods, despite a careful system of banks along the Mississippi. In Texas, on the other hand, the cotton area is a long way from the sea, and although the rainfall is generally sufficient, being 30 inches per annum, in certain areas droughts occur occasionally which seriously reduce the yield of the year's crop. The American climate tends to great extremes and to considerable uncertainty, and the crop is often reduced by excessive rains or even by moderate rains at the wrong time, such as during the picking season. Nor must the importance of the frost be overlooked, for an early frost may cut short the development of the late maturing bolls or top crop as it is called, and thus reduce a large prospective crop to a meagre one.

Varieties

The best Sea Island cotton is grown in quite a small area, consisting of a number of islands lying off the coast of South Carolina opposite Charleston; but a very good quality of Sea Island cotton comes from Florida, Georgia and certain portions of South Carolina, and is grown from island seed specially imported. Long-staple Upland cotton, the best of which is but little below second grade Sea Island in length of staple, is grown in the Yazoo Delta and in several small areas scattered throughout the Belt. But the majority of the crop consists of ordinary Upland cotton and forms the bulk of the supply to the cotton industry, both in America and Lancashire. A fairly complete description of the methods of cultivation and picking has already been given in the introductory chapter, but it is well to draw attention to the methods of storing which is customary in large areas.

Although in Texas the cotton crop is generally taken straight into the wagons and thence into the ginnery at once, in the Atlantic States it is generally left lying in heaps on the side of the field for some time. In other districts it is stored in small huts till enough has accumulated to make a bale of about 1,500 lb. of seed cotton. This custom is advocated by many planters on the ground that cotton improves by being stored for about a month before ginning, as this allows it to dry thoroughly, and also any unripe fibre grows slightly and absorbs the oil in the seed, so that the cotton obtains a more uniform staple and a stronger fibre with better colour. Many experts, however, disagree. Mr. John Todd, whose work on the world's cotton crops is particularly valuable when dealing with American cotton, was unable to find any justification for this theory, although he had investigated the facts on the spot.

History of Cotton Growing in America

It is not necessary to give a lengthy historical sketch of cotton growing in America, but a few salient facts will prove of interest.

Cotton was found growing wild by Columbus in the West Indies, but its growth as a cultivated product was first reported in Virginia in 1621. Its progress seems to have been slow, as the first report of its being grown on any considerable scale in South Carolina and Georgia occurs in 1733. The first exports to England are recorded in 1739, from Virginia, and from Charleston not till 1747. But it was not until nearly the end of the eighteenth century that the export of cotton became of real importance.

The development of the industry was retarded by the primitive methods used for ginning, and it was not till 1793, when Ely Whitney invented the saw-gin, which event was coupled with the introduction of slave labour, that the planting of the crop developed considerably. By 1794 the crop was nearly three times that of 1792, and the price, which was 44 cents per lb. in 1798, encouraged further extension. In 1826 a million bales had been reached, and by 1851 three million, while the crop of 1861, which was the last before the American Civil War, totalled some 4,500,000 bales. The Civil War almost destroyed the industry, and in 1864 only approximately 300,000 bales were produced. In the next year, the war being finished, the crop was 2,314,000. By 1870 it had reached four million bales, and from that date progress has been most rapid, till it reached 16,043,000 in 1911. Since 1914 the total crop has tended to decline, and this, coupled with greatly increased world consumption, has brought about a very serious position for all cotton manufacturing centres. The difficulty is that apparently the whole area which can satisfactorily be brought under cultivation for cotton has now been brought into use, and, if anything, the tendency is to reduce rather than increase the total acreage. 1913 would appear to be the high-water mark, although 1918 approaches it very nearly so far as acreage is concerned.

The Reason why it is Difficult to Increase the Acreage

As the world's consumption of cotton is increasing faster than the production, this has naturally led to a rise in the price of raw cotton which one would have expected would have led to a considerable increase in acreage, for it is not as if all suitable land had been taken up. The principal causes for the failure to increase the acreage, and which indeed looks likely to actually reduce it, are numerous, but the most important are the boll weevil and the bad labour supply. The boll weevil has already been described in an earlier part, and here it is only necessary to add that it has progressed steadily throughout the whole cotton Belt until it now covers almost the whole of it, with the exception of the two Carolinas.

Nor has any really effective method been devised for checking its depredations. Within the last two or three years it has reached the Sea Island cotton which heretofore has been outside the area of its ravages. This pest was first discovered in Mexico in 1862, but did not attack the American crop till 1892, when it appeared at Brownville, Texas. Since then it has steadily spread year by year till practically the whole area, with the above mentioned exception, has been involved. The weevil does most damage in the early autumn, and therefore it is the later maturing bolls which are its special victims. These constitute the top crop which, if there is a late frost, will usually make all the difference between a profitable crop and a comparative failure. It may thus well be that a planter, owing to the ravages of this pest, may lose such a large part of his crop that he will not be inclined to increase the area under cotton cultivation, no matter how high prices rise, and unless checked it is quite possible that large areas will go entirely out of cultivation so far as cotton is concerned; indeed, there are not lacking signs that many planters are tending to plant crops not susceptible to its ravages.

Every effort to discover some real cure for this pest has been made, so far with but little success. The best method appears to be the breeding of earlier maturing kinds of cotton, so that the bulk of the crop shall have reached maturity in time to resist the worst attacks by the boll weevil. This, however, necessitates a careful selection, and a special breeding of suitable kinds of seed, a matter in which, so far, little encouragement has been given to the scientific experts by the planters, with a few notable exceptions. And even if the boll weevil were successfully exterminated, the second difficulty would remain and each year become more acute. Cotton is essentially a cheap labour crop and can only be profitably grown where there is an ample supply of cheap labour. Since the liberation of the slaves the average nigger, who constitutes practically the whole of the labour supply in the cotton Belt, has refused to work more than two or three days a week, as in that time he can earn a sufficient wage to keep him for the whole week, and nothing will persuade him to work six or seven days a week, even in the busiest part of the picking season when, owing to the variability of the weather, a day's delay may mean ruin to the crop. Even when the land and crop are his own, he has no desire to save money or rise to a position of affluence, his one object in life being to have an easy time. Herein he differs entirely from the Egyptian fellah, who will work steadily day in and day out for a much lower wage than that demanded by the nigger, and who appears to have a genuine aspiration for improving his position in life.

The result of the negro's attitude is not only that the labour cost has increased out of all proportion to the rise in price, but in many districts labour is absolutely unobtainable in sufficient quantities for the proper cultivation of the crop. Deep ploughing is impossible, and at the picking season insufficiency of labour causes heavy loss. Ownership of the crop not only appears to be no inducement to work harder, but no matter what the condition of the crop may be, custom alone dictates the proper time for him to start the harvest. Thus, if the crop matures early in August, while the weather is still very hot, nothing will persuade him to go into the fields and pick it, although the delay may bring rain which will quickly reduce the value of the standing crop by nearly half. Cotton is often left standing in the field throughout the winter and even into the early spring. Probably at least a quarter of the total crop is lost each year through this factor alone, and a great deal of what is actually harvested is found to be in bad condition through no other cause. It is difficult to say precisely what wages are paid in the different areas, as they vary from year to year, but it is seldom less than 85 cents per 100 lb.

Attempts to meet the labour shortage by means of various kinds of mechanical cotton pickers have not resulted in a great reduction in the amount of labour required. In addition to the dearness and shortage of labour, the cost of everything else connected with the industry has rapidly increased during recent years. Fertilizers, implements, seed, have all gone up in price, and the result is that the actual net cost of production, after deducting the value received and not allowing for rent or interest on the price of the land, where there is a yield of 200 lb. per acre, even in pre-war days, was very often 4¼*d.* per lb. Thus, if the cost of rent and the living wage for the planter be added, at least 6*d.* per lb. would be necessary, and if, as often happens, less than 200 lb. per acre is harvested, a planter is liable to be faced with a heavy loss. In short, except where a large amount of child labour is obtainable, one cannot honestly see that there is any advantage in increasing the actual acreage under cultivation. The only satisfactory method would appear to be to go on a different line, namely to increase the amount of cotton produced per acre and by greater economy in the methods of handling after it has left the plantation. It is probably hardly realized how much good cotton is damaged and lost in the time between its leaving the plantation and its arrival in Liverpool.

Increasing the Yield

Whereas in Egypt 450–500 lb. per acre is quite an average output of lint, 200 lb. per acre represents the usual amount in America. It has been proved in every case where up-to-date methods of cultivation have been employed, that the American output can be very considerably increased, and the same methods that increase the yield also tend to improve the quality. The first essential, however, here, as everywhere, is the improvement of the seed supply. Unfortunately the average small grower pays little attention to the quality of the seed employed. He makes no attempt, as a rule, even to select his own seed. In the ginneries no attempt is made to prevent the mixing of seeds : seed from the same plantation is used year after year, and inevitably deterioration results. There is no doubt that new varieties of Upland can be obtained which would give far better results both in yield and quality than those at present employed. The Federal and State Departments of Agriculture have placed on the market many new varieties of excellent cotton of quite 1 inch in staple ; but it appears to be impossible to convince the ordinary small grower, and particularly the negro, to pay a little more money to get better seed. This is not entirely the fault of the grower, but is, in part at least, due to the inefficient and unsatisfactory methods employed in marketing the crop. While the large export firms in New Orleans, Galveston, etc., have their own buyers who buy up cotton of all grades from the small markets, towns and villages and forward it to their headquarters, where it is graded and classified, there are also a number of small independent merchants who buy to sell again to the big export houses. Unlike the first body of men, this latter group know very little about the quality of cotton they buy, and therefore are unwilling to pay a higher price for good quality. The result is that the planters who can only sell in the small towns have to take whatever is offered them. This means that they are discouraged from trying to grow better cotton than their neighbours. Although it will cost them more money and cause them more trouble, they may not get a higher price in the end, unless they can get into touch with one of the big buyers.

Ginning

In addition to this defect, many ginning establishments are by no means up-to-date, although in recent years considerable improvements have been made, and the old gins driven by horse or mule, or at best, by water power, are being replaced by modern steam or electric plant ; and in these cases the flat bales they turn out are very creditable. Numerous labour-saving devices have been evolved. Thus in many cases cotton is taken straight from the farmers' wagons by a pneumatic suction pipe which draws every particle of cotton out of the wagon in a short time. The cotton is carried direct into a system of hoopers over the gin stands, from which it falls through beaters or funnels for cleaning purposes into the gins below. Usually each gin has about seventy circular saws running at about 400 revolutions per minute. The upper edges of these saws pass through slots in the frame and pull the lint through, while the seed falls back into a trough, along which it passes by suction into the store outside. The lint is drawn likewise by suction into a closed lint flue that runs behind all the gin stands. At one end of this lint flue a small pipe is inserted, so that in case of a " flash fire " in the flue a jet of steam may be turned on to the cotton, which at this time is in an extremely inflammable condition.

The lint flue leads on into the condenser, where the cotton is formed into a loose " lap " and falls in folds into a press box. The pressing machinery, as a rule, is of the double press box type, having a screw press worked by steam from below and moving on a circular platform, level with the floor of the ginneries.

One box is placed beneath the condenser, and when full is swung over the screw press, while the other box takes its place under the condenser. While the box is being filled the cotton is generally pressed down every half minute by a mechanical packer from above. Here, however, the first trouble begins to arise, which often leads to very serious loss. Where the ginnery is steam driven, as is usually the case, this packer is operated by a steam cylinder vertically above the press box. When this cylinder is only working for a few seconds every half minute, there is a tendency to condensation, and unless the piston is carefully packed and regularly attended to, the condensed steam trickles down on to the cotton. Moreover, if there is a temporary stoppage of the gins for meal times or any other cause, the operator seldom takes the trouble to swing the press box half round so as to clear the drip from the packer, with the result that even a small leakage may produce quite a serious wet spot in the very heart of the bale. This wet spot will spread through the whole side of a bale and ruin it by "felting" a large proportion of the contents. This is the probable cause of nine-tenths of the "water packed" bales which cause so much trouble and loss to spinners. Naturally when the spinner receives the bale six months or a year later he finds the small damp spot has spread into a lump of rotten and felted cotton weighing many pounds.

Here, again, the principal real cause is inefficient and unconscientious labour. It would be quite possible to avoid most of this damage by a little care in manipulating the packer.

Baling and Packing

Recently the Export and Shipping Associations have made strenuous efforts to secure the adoption of a standard size of press box, and consequently a standard bale of 27 in. × 54 in. containing 500 lb. The covering consists of two pieces of jute sacking, which are not sufficiently large to meet over the ends or the flat sides of a bale. Six bands are put round the bale in the press, and the total weight of tare is about 20 lb. As soon, however, as the flat bale leaves the press, its treatment is most unsatisfactory. Even if the ginner is himself the purchaser of the cotton, the first thing he does is to slash a hole in the canvas of the rounded sides and to draw from the hole a sample of about 1 lb. in weight. He might have saved damaging his bale by taking it from the press box before it was baled, but, if asked why he has not adopted that simple procedure, his only excuses are that it is not the custom and that a sample of unpressed cotton does not look the same as a sample after it has been pressed. Again, if asked why the sample could not have been taken from the uncovered sides or ends of the bale so as to avoid cutting the packing, his excuse is that a sample taken from the top or bottom opens up like the leaves of a book, just as the cotton fell in folds into the press box, and it would be more difficult to draw a sample from the hard pressed sides. Experts agree that this question of sampling lies at the root of the whole question of American bales ; for every prospective buyer considers it his perquisite to take a similar sample of every bale he looks at, and as no one will take a sample from an old hole the bale is cut to pieces.

Lack of Shelter

If not sold at once, a bale lies in the town yard, or possibly in the farmer's own yard, totally unprotected from the weather, and as the rainfall is often heavy, the bale naturally deteriorates. When the cotton is sold at last, the bale is shipped to the most convenient port after first going to the nearest compress to put it in order. The custom of the trade empowers the railway company to have the flat bale repressed at the nearest compress to the point where the cotton is received in order to reduce the demands on wagon space. Some of it goes by river, and as these river steamers have little free board, the amount of water splashed up on the lower tiers of bales is considerable. On reaching the compress it is unbanded again, the top and bottom cloths being held together temporarily by wire clips. On being placed in the compress rough pieces of sacking are thrown over it to cover the sample holes in the original packing. Eight bands are now slipped round the bale in the press, and in the general hustle it is not surprising, in view of the inefficiency of negro labour, that the bale finally leaves the compress in a very unsatisfactory condition, the tare increased by the sample patches, the bales insecurely fastened, besides half uncovered, and the bands likely to break with any severe wrench. Any one who has seen cotton bales from America being landed in Lancashire will admit that they look more disreputable than bales sent from any other country in the world. When compared with the excellent bales sent out from Egypt, the difference is remarkable, and the real cause is that there is no one, as a rule, who has any "through" interest in the bales.

In Egypt the whole system is centred in the large export houses of Alexandria, who also control the majority of the ginneries and who actually buy in most cases direct from the growers. As a natural result, from the moment the cotton is picked its treatment is under the eye of some one who has a direct interest in producing the best final results. In America, on the other hand, the cotton constantly changes hands, and the first sampler has no more interest in the cotton after he has passed it on to the next buyer. Nor must the frantic speed at which everything in America is supposed to be done be overlooked. With the inefficient negro labour, the breakneck speed at which the compresses work, rendering efficient workmanship next to impossible, it is probable that no suitable remedy will be found until some large corporation owning its own ginneries and buying direct from the growers on the one hand, and shipping direct to Liverpool on the other, comes into existence. Such a corporation would be able to dispense with most of the sampling and might even substitute certificates based on press box samples for the cruder method of sampling bales haphazard. It will thus be seen that as things are at present very little increase in the total supply of cotton in the U.S.A. is likely in the near future, and an actual decrease is quite possible.

Before leaving the subject of America it will be necessary to consider the increased demand of American manufacturers. In recent years the home consumption in the States has gone up by leaps and bounds, and since there is little prospect of an increased supply from the cotton Belt, other countries will more and more be faced with a cotton shortage bordering on a cotton famine unless new areas can be discovered.

The production by the States of Upland and Sea Island cotton, with the rank of each State in the production of cotton and also the production of linters, is shown in Table III., the totals being given for the years 1914–17, and the actual output per State for the year 1917 only. These figures, which are obtained from the American Department of Commerce Report, give a very fair idea of the total output of the cotton area. Table IV. shows the gross weight and estimated value of lint cotton and of cotton seed for the United States from 1914–17.

Sea Island Cotton

The Sea Island cotton crop is the most valuable per pound of all cotton crops in the world, and its importance, particularly to the lace industry of Leicester, is well known. Unfortunately it appears to be steadily declining in quantity, largely owing to the ravages of the boll weevil and other pests. The crop of 1917 amounted to only 35,990,000 lb. gross weight or 92,619 running bales, which was 24,940 bales less than the amount returned for the preceding crop. Attempts to grow it in areas outside Florida, Georgia and South Carolina have failed, although a few bales have been produced in Texas and Louisiana. The best Sea Island cotton is grown on the islands off the coast of South Carolina by planters who have for many years paid the utmost attention to seed selection, and growers who raise Sea Island cotton in the interior must secure new seed from the coast region at frequent intervals in order to preserve the quality of the fibre, which otherwise quickly degenerates into an ordinary Upland fibre when grown away from the coast. The only other important area in which Sea Island cotton is now grown is in some of the West Indies, which compares very favourably with the best qualities grown in South Carolina; but the total export of cotton from the West Indies, not all of which was Sea Island, for 1913 was only 6,145 bales of 500 lb. each.

TABLE III.

State.	Growth Year.	COTTON PRODUCED (EXCLUSIVE OF LINTERS). Running Bales, counting round as Half-Bales.	Equivalent 500-lb. Bales. Gross.	Equivalent 500-lb. Bales. Net.	Total.	Running Bales. Upland. Square.	Running Bales. Upland. Round.	Running Bales. Sea Island.	Per Cent. of Total Ginned.	Rank in Production.*	LINTERS. Running Bales.	LINTERS. Equivalent 500-lb. Bales. Gross.	LINTERS. Equivalent 500-lb. Bales. Net.
United States	1917	11,248,242	11,302,375	10,812,701	11,342,780	11,061,085	189,076	92,619	100·0	—	1,096,422	1,125,719	1,077,476
	1916	11,363,915	11,449,930	10,955,816	11,460,084	11,150,186	192,339	117,559	100·0	—	1,300,163	1,330,714	1,273,507
	1915	11,068,173	11,191,820	10,708,812	11,124,031	10,920,471	111,716	91,844	100·0	—	944,640	931,141	889,577
	1914	15,905,840	16,134,930	15,437,955	15,934,649	15,795,377	57,618	81,654	100·0	—	832,401	856,900	820,274
Alabama . .	1917	520,906	517,890	494,971	520,906	520,906	—	—	4·6	9	51,712	50,177	47,901
Arizona . .	1917	21,140	21,737	20,807	21,140	21,140	—	—	0·1	14	(2)	(2)	(2)
Arkansas . .	1917	953,587	973,752	931,799	953,742	953,431	311	—	8·6	4	80,789	83,051	79,496
California .	1917	58,974	57,826	55,231	58,974	58,974	—	—	0·5	12	(2)	(2)	(2)
Florida . .	1917	48,178	37,858	36,634	48,178	10,851	—	37,327	0·3	13	(2)	(2)	(2)
Georgia . .	1917	1,885,054	1,883,911	1,802,120	1,885,054	1,837,075	—	47,979	16·7	2	189,169	190,164	182,641
Louisiana .	1917	629,719	638,729	611,052	630,669	628,769	1,900	—	5·7	7	50,495	51,853	49,631
Mississippi .	1917	886,269	905,554	866,558	886,269	886,269	—	—	8·0	6	114,891	122,018	116,963
Missouri .	1917	58,937	60,831	58,238	58,937	58,937	—	—	0·5	11	(2)	(2)	(2)
N. Carolina	1917	656,656	617,989	589,097	656,656	656,656	—	—	5·5	8	59,710	60,936	58,309
Oklahoma .	1917	955,342	959,081	918,191	991,117	919,567	71,550	—	8·5	5	78,591	81,123	77,665
S. Carolina .	1917	1,267,135	1,236,871	1,181,292	1,267,135	1,259,822	—	7,313	10·9	3	85,236	84,995	81,244
Tennessee .	1917	238,806	240,525	230,017	238,806	238,806	—	—	2·1	10	66,543	71,650	68,722
Texas . .	1917	3,041,726	3,125,378	2,993,387	3,099,384	2,984,069	115,315	—	27·7	1	287,617	296,981	284,326
Virginia. .	1917	20,155	18,777	17,890	20,155	20,155	—	—	0·2	15	—	—	—
All other States (1).	1917	5,658	5,666	5,417	5,658	5,658	—	—	0·1	16	31,669	31,971	30,578

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* Based on equivalent 500-lb. bales, excluding linters.

(1) Includes Kansas, Kentucky, and New Mexico, and the linter production of California, Florida, Illinois, and Missour

(2) Included in "All other States" to avoid disclosure of individual operations.

TABLE IV.

	Lint Cotton.						Cotton Seed.		
State.	Growth Year.	Aggregate Value of Cotton Crop.	Total Value.	Total.	Gross Weight Upland.		Sea Island.	Quantity.	Value.
					In square Bales.	In round Bales.			
		$	$	lb.	lb.	lb.	lb.	Tons.	$
United States	1917	1,866,240,000	1,532,690,000	5,651,190,000	5,568,180,000	47,020,000	35,990,000	5,040,000	333,550,000
	1916	1,253,130,000	991,060,000	5,724,960,000	5,629,540,000	48,920,000	46,500,000	5,113,000	259,070,000
	1915	795,840,000	627,940,000	5,595,910,000	5,532,220,000	28,100,000	35,590,000	4,992,000	167,900,000
	1914	720,080,000	591,130,000	8,067,470,000	8,020,610,000	14,570,000	32,290,000	7,186,000	128,950,000

AMERICAN EGYPTIAN.

TABLE V.

Year.	Cotton Lint in 500-lb. Bales.	Estimated Value of Lint.	Estimated Value of Seed.	Estimated Total Value of Crop.
		$	$	$
1912	375	39,000	5,000	44,000
1913	2,135	197,000	28,000	225,000
1914	6,187	483,000	50,000	533,000
1915	1,095	119,000	10,660	129,660
1916	3,331	699,500	86,400	785,900
1917	15,966	5,482,000	619,770	6,101,770

American Egyptian Cotton

The increasing demand for Egyptian cotton by American manufacturers has led to attempts to grow Egyptian varieties in the States. During 1918, 85,000 acres were planted with the American Egyptian cotton as compared with 33,000 acres in 1917, which was the largest previous acreage. Eighty per cent. of this acreage is planted with the Pina variety, which has an average length of fibre of $1\frac{5}{8}$ inches. Of the 1918 crop, 78,000 acres were in the Salt River and Gila Valleys in Arizona, and Table V. gives the production of this cotton in 500-lb. bales for the years 1912–17.

Long Staple Upland Cotton

With the increased demand for superior staple cottons efforts have been made to increase the quality of some of the Upland cottons, and Table VI., obtained from the American Department of Agriculture, is instructive.

There was a total of 1,354,000 bales of Upland cotton having a length of $1\frac{1}{8}$ inches or over in 1917, showing an increase for this length of crop over 1916, when the figure was 1,009,000 bales, while the figure for 1915 was only 832,000. The long staple varieties are chiefly grown on better soils and by the most progressive farmers who pay particular attention to the crop. The most important States producing long staple Upland cotton in 1917 were, in the order of quantity grown: Mississippi, Texas, Arkansas, Oklahoma and South Carolina.

The Number of Ginneries

The number of ginneries, both active and idle, as reported each year from 1914–17, and the average number of running bales ginned per shipment, are shown in Table VII. The tendency appears to be to reduce the number of separate ginneries, improving and enlarging, more modern and up-to-date, with the result that the average number of bales ginned per establishment has tended to increase.

TABLE VI.

State.	Long Staple.				Short Staple under 1⅛ inches.		Sea Island and Egyptian.	
	Over 1¼ inches.		1⅛–1¼ inches.					
	1917	1916	1917	1916	1917	1916	1917	1916
	Percentage of Total Crop.							
United States	1·2	1·3	10·8	8·3	87·3	90·4	0·8	0·7
	Yield of Lint per Acre (Pounds).							
Do.	184·9	*	174·8	160·0	161·3	163·0	136·6	128·0
	Average Price per Pound received by Growers about Dec. 1 (Cents).							
Do.	43·4	*	33·5	—	27·6	19·1	72·0	46·1

* Not available for 1916; combined with 1⅛ to 1¼ inches.

† TABLE VII.

State.	Number of Ginneries.				Average Number of Running Bales Ginned per Establishment.
	Growth Year.	Total.	Active.	Idle.	
United States	1914	27,339	24,547	2,792	648
	1915	26,721	23,162	3,559	478
	1916	25,999	21,624	4,375	526
	1917	24,272	20,351	3,921	553

Consumption of Cotton

The total number of cotton spindles, that is spindles used exclusively for spinning cotton fibre and excluding those which consume cotton mixed with other fibres, was in 1918, 34,940,830, or 653,830 more than the number of the previous year. Figures showing the number of spindles and the quantities of raw cotton and linters consumed, etc., are given in Table VIII. Massachusetts exceeded every other State, having 11,512,247 or 32·9 per cent. of the total, and South Carolina ranked second with 4,903,840 or 14 per cent., North Carolina being third with 4,591,026 or 13·1 per cent. In addition to the spindles designed to spin cotton, 446,503 spindles were returned as having consumed raw cotton mixed with other fibres.

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† All the tables in this Chapter are from the Reports of the American Agricultural Department.

The Localization of Cotton Spinning in the States

Sixty-five counties in the United States have more than 100,000 cotton spindles each or 82 per cent. of the aggregate of the country. Of these counties three have 29·4 per cent. of the aggregate of the United States. Bristol County, Massachusetts, has 7,459,216 cotton spindles and led all other counties, and had 64·8 per cent. of the total spindles of Massachusetts and 21·3 of the total for the United States. Providence County, Rhodes Island, with 1,738,045 cotton spindles, was second, and Middlesex County, Massachusetts, third, with 1,096,002. The number of active ring and mule cotton spindles in the United States from 1913–18 were as given in Table IX.

Of the 34,542,665 active cotton spindles of the United States in 1918, only 3,521,916 or 10 per cent. were mule spindles. This compares with 4,922,839 or 17·5 per cent. of the total in 1909. Indeed there has been a continual decrease, not only in the actual number but also in the proportion. Manufacturers tend more and more to use frames rather than mules where it is practicable because of the ease with which ring spindles can be operated, and new mules are seldom installed except where fine filling yarns, soft twisted knitting yarns, or very coarse yarns made from short-staple cotton or waste are to be spun. The use of mule spindles is confined largely to New England States, which reported 80·8 per cent. of the total number in the country in 1918.

TABLE VIII.

State and Year.	Cotton Spindles.		Spindles Consuming Cotton Mixed with other Fabrics.	Cotton (exclusive of Linters).				Linters.	
				Consumed (Bales).		Stocks in Consuming Establishments at end of Year (Bales).		Consumed (Bales).	Stocks in Consuming Establishments at end of Year (Bales).
	Total.	Active.		Total.	Foreign.	Total.	Foreign.		
United States:									
1913	32,149,617	31,519,766	454,733	5,483,321	232,929	717,704	79,979	303,609	60,454
1914	32,744,012	32,107,572	414,058	5,577,408	194,309	675,873	64,149	307,325	75,346
1915	32,840,730	31,964,235	394,505	5,597,362	222,057	1,401,185	108,782	411,845	198,905
1916	33,333,176	32,805,883	405,000	6,397,613	316,995	1,632,245	142,518	880,916	100,441
1917	34,221,252	33,888,835	452,525	6,788,505	318,261	1,501,916	94,311	869,702	112,972
1918	34,940,830	34,542,665	446,503	6,566,489	183,794	1,465,223	62,684	1,118,840	138,108

TABLE IX.

Year.	Total.	Ring.	Mule.
1913	31,519,766	27,380,573	4,139,193
1914	32,107,572	28,016,390	4,091,182
1915	31,964,235	28,122,792	3,841,443
1916	32,805,883	29,094,263	3,711,620
1917	33,888,835	30,264,074	3,624,761
1918	34,542,665	31,020,749	3,521,916

Cotton Consumed

The quantity of cotton consumed in the United States during the year ended July 31, 1918, was 6,566,489 bales, compared with 6,788,505 bales in 1917, 6,397,613 bales in 1916, and 5,597,362 bales in 1915. Of the total consumption of cotton during the year ended July 31, 1918, 6,296,756 bales were Upland, 85,939 Sea Island, and 183,794 were foreign cottons. In the cotton-growing States the consumption was 3,697,098, and in all other States 2,869,391 bales. The bales used are running bales and are about equivalent to 500-lb. bales.

The foreign cotton was mostly Egyptian and was used for mercerizing, for underwear and lace curtains, for automobile tyres, and in the manufacture of sewing thread. A certain amount of rough Peruvian cotton was used for mixing with wool in the making of wool textiles, while Chinese and Indian cottons are tending to be imported in increasing quantities, for mixing with American Upland cottons in the manufacture of cheap grade goods.

Table X., showing the quantity of the several kinds of raw cotton consumed and of stocks held in the consuming establishments in 1915–18, is particularly significant.

Linters Consumed

During the War the increased demand for gun cotton and smokeless powder led to the utilization of linters for this purpose, to the almost total exclusion of its use for the manufacture of mattresses and bedding. In 1918, 1,118,840 bales were consumed, as compared with 869,702 bales in 1917, 880,916 bales in 1916, and 411,845 bales in 1915.

Growth of the Cotton Industry in the States

Since 1890 the number of spindles in the United States has more than doubled, while the quantity of cotton and linters consumed in 1918 was more than four times that for 1890.

TABLE X.

Kind and Locality.	Raw Cotton Consumed during Year (Bales).				Stocks held in Consuming Establishments at end of Year (Bales).			
	1918.	1917.	1916.	1915.	1918.	1917.	1916.	1915.
United States	6,566,489	6,788,505	6,397,613	5,597,362	1,465,223	1,501,916	1,632,245	1,401,185
Domestic :								
Upland	6,296,756	6,375,953	5,997,973	5,295,911	1,382,539	1,371,123	1,462,273	1,267,484
Sea Island	85,939	94,291	82,645	79,394	20,000	36,482	27,454	24,919
Foreign :								
Egyptian	136,401	259,160	269,324	181,211	35,917	75,250	123,406	96,828
Peruvian	5,802	12,800	10,886	10,529	2,167	1,965	1,809	1,739
Chinese	35,637	42,612	32,347	26,501	21,710	15,188	16,147	8,903
Other	3,254	3,689	4,438	3,816	2,890	1,908	1,156	1,312
Cotton-growing States	3,697,098	3,888,348	3,527,528	3,026,969	577,563	609,090	684,654	577,201
Domestic :								
Upland	3,670,198	3,836,749	3,488,816	2,996,180	564,362	594,820	667,787	567,364
Sea Island	13,022	26,724	23,574	17,133	4,677	6,568	5,093	3,658
Foreign :								
Egyptian	8,468	18,022	9,394	7,794	1,407	6,210	9,749	4,463
Peruvian	—	—	1	153	1	—	—	—
Chinese	5,410	6,805	5,618	5,648	7,116	1,492	2,025	1,710
Other	—	48	125	61	—	—	—	6
All other States	2,869,391	2,900,157	2,870,085	2,570,393	887,660	892,826	947,591	823,984
Domestic :								
Upland	2,626,558	2,539,204	2,509,157	2,299,731	818,177	776,303	794,486	700,120
Sea Island	72,917	67,567	59,071	62,261	15,323	29,914	22,361	21,261
Foreign :								
Egyptian	127,933	241,138	259,930	173,417	34,510	69,040	113,657	92,365
Peruvian	8,502	12,800	10,885	10,376	2,166	1,965	1,809	1,739
Chinese	30,227	35,807	26,729	20,853	14,594	13,696	14,122	7,193
Other	3,254	3,641	4,313	3,755	2,890	1,908	1,156	1,306

The industry is growing more quickly in the cotton-growing States than elsewhere. In 1880 there were only 561,360 cotton spindles in these States, and the quantity of cotton consumed was 188,748 bales. In 1918, 14,529,063 spindles were operating, and the quantity of cotton and linters consumed was 4,414,052 bales. Between 1900 and 1918 the consumption in the cotton States almost trebled, whereas in the New England States it only increased 38·4 per cent. and in all other States 42·6 per cent. In 1900 the cotton-growing States consumed 39·3 per cent. of the total consumed in the country; the New England States consumed 49·3 and the other States 11·4 per cent. In 1918 the cotton-growing States consumed 57·4 of the total, the New England States 34·4, and all other States only 8·2 per cent. Table XI. shows the production and con-

TABLE XI.

UNITED STATES.

Year.	Cotton Produced (Bales.)	Cotton Consumed (Bales.)	Active Cotton Spindles.
1840	2,063,915	236,525	2,284,631
1850	2,469,093	575,506	3,998,022
1860	5,387,052	845,410	5,235,727
1870	3,011,996	796,616	7,132,415
1880	5,755,359	1,570,344 *	10,653,435 §
1890	7,472,511	2,518,409	14,384,180
1900	9,507,786	3,873,165	19,472,232
1905	13,697,310	4,278,980 †	23,687,495
1906	10,725,602	4,909,279	25,250,096
1907	13,305,265	4,984,936	26,375,191
1908	11,325,882	4,539,090	27,505,422
1909	13,432,131	5,240,719	28,018,305
1910	10,386,209	4,798,953	28,266,862
1911	11,965,962	4,704,978	29,522,597
1912	16,109,349	5,367,583	30,578,528
1913	14,090,863	5,786,330	31,519,766
1914	14,613,964	5,884,733	32,107,572
1915	16,738,241	6,009,207	31,964,235
1916	12,012,813	7,278,529	32,805,883
1917	12,664,078	7,658,207	33,888,835
1918	12,344,664	7,685,329	34,542,665

* Relates to crop of preceding year.
† Does not include Foreign Cotton.
§ Cotton mills only.

sumption of cotton in the United States from 1840 to 1918, and indicates very plainly an enormous and disproportionate increase in home consumption and production.

Stocks of Cotton

The amount of baled cotton held in the United States on July 31, 1918, was 3,450,188 bales, and Table XII. indicates the exact position from August, 1917, to July, 1918, month by month.

Imports and Exports of Cotton

Practically the entire quantity of cotton consumed in the United States is produced in that country, only small quantities for special purposes being imported. The total quantity of cotton imported into the United States during the year ended July 31, 1918, amounted to 221,216 bales of 500 lb. each, and of this 3,835 bales were re-exported, reducing net imports to 217,381 bales. Nearly all the imported cotton was Egyptian, used largely for mercerizing, etc. During the same year 35,726 bales of Mexican cotton was imported, and in addition some 38,964 bales came from China and 19,692 were Peruvian, which is used, as already stated, for mixing with wool in the manufacture of woollen goods.

Exports

The yearly exports of domestic raw cotton and linters for the year ended July 31, 1918, amounted to 4,476,124 bales, being the smallest since the returns were made and only about two-fifths of the quantity exported in 1912. New York, with 881,610 bales, was the largest port of export, followed by Galveston with 785,389, New Orleans with 743,083, Georgia with 625,745, and Washington with 444,717 bales.

Before closing this chapter, it will be well to show a table

TABLE XII.

Month.	Year.	COTTON.						LINTERS.		
		Consumed.			On Hand.			Con-sumed.	On Hand.	
					In Consuming Establishments.		In Public Storage and at Compresses.			
		Total.	In Cotton-growing States.	In all other States.	In Cotton-growing States.	In all other States.			In Con-suming Establish-ments.	In Public Storage and at Com-presses.
August . . .	1917	569,488	330,669	238,819	389,685	789,487	746,707	78,896	114,300	144,891
September . .	,,	522,389	299,294	223,095	297,908	661,244	1,575,786	89,171	100,736	100,398
October . . .	,,	584,946	324,528	260,418	530,058	545,801	3,031,980	100,155	69,743	93,754
November . .	,,	590,427	332,504	257,923	867,082	538,629	3,763,138	80,948	90,937	114,666
December . .	,,	516,498	286,719	229,779	995,053	581,473	3,810,681	75,449	111,447	142,488
January . . .	1918	523,947	302,098	221,849	1,060,997	594,182	3,609,092	69,817	131,063	172,235
February . .	,,	510,084	296,366	213,718	1,063,673	632,282	3,399,406	87,961	158,342	200,298
March . . .	,,	571,443	313,264	258,179	1,064,414	656,022	3,250,951	109,267	145,766	255,541
April	,,	544,125	305,538	238,587	1,016,897	790,891	2,828,126	106,232	154,155	279,973
May	,,	575,862	317,266	258,596	888,225	905,070	2,404,223	110,543	168,084	276,972
June	,,	515,823	285,401	230,422	742,829	930,300	2,116,193	102,496	154,455	285,785
July	,,	541,457	303,451	238,006	577,563	887,660	1,734,965	107,905	138,108	236,809

(Table XIII.), indicating the world's production of commercial cotton by countries for 1913–17. The bales have been expressed in this table in figures equivalent to bales of 500 lb. net weight so as to provide a practical unit for comparative purposes. The total for 1917, namely 17,410,000 bales, does not include linters in the United States, which item would add 1,077,476 bales to the total. The 1917 crop was the smallest for any year covered by the table, being less than that of 1914 by 6,456,000 bales. The United States contributed 62·1 per cent., India 17·5 per cent., Egypt 7·4 per cent., China 4·8 per cent., Russia 3·3 per cent., Brazil 2·3 per cent., all other countries 3·6 per cent.

TABLE XIII.

COTTON PRODUCTION (BALES OF 500 LB. NET).

Country.	1917.	1916.	1915.	1914.	1913.
Total .	17,410,000	18,095,000	17,609,000	23,866,000	21,618,000
United States .	10,811,000	10,956,000	10,709,000	15,438,000	13,545,000
India* . . .	2,869,000	3,242,000	2,630,000	3,807,000	3,692,000
Russia . . .	578,000	1,065,000	1,465,000	1,247,000	1,030,000
Egypt . . .	1,287,000	1,015,000	912,000	1,384,000	1,496,000
China † . . .	830,000	810,000	845,000	750,000	620,000
Brazil . . .	400,000	309,000	250,000	440,000	420,000
Mexico . . .	125,000	140,000	125,000	125,000	150,000
Peru	110,000	108,000	93,000	103,000	110,000
All other countries . . .	400,000	450,000	580,000	572,000	555,000

* The amounts for India do not include cotton used in home manufacture, although such cotton is included in the reports of cotton produced compiled by the Indian Government.

† Consists of cotton exported and cotton consumed in spinning mills.

From what has been written above it is abundantly evident that the cotton situation in the near future is likely to be one approaching a cotton famine, and the effect of this on European countries, who more and more are tending to use cotton instead of other materials for clothing, will be exceedingly serious unless drastic measures are adopted, either for increasing the total supply or substituting some other fibre for the use of cotton in many articles in which it is at present consumed.

(B) MEXICO AND CENTRAL AMERICA

Although Mexico appears to be able to produce very considerable quantities of cotton, at the present time her crop is comparatively meagre, averaging less than 200,000 bales per annum. Cotton is grown in small quantities throughout almost the whole country, thus showing that the bulk of this area, which is larger than that of the whole American cotton belt, is suitable for cotton growing. In the valley of the Colorado adjoining the Imperial Valley in the United States, it has been proved that Egyptian and American long-staple cottons can be successfully grown on irrigated land. In many ways the country is an ideal cotton-growing area, and, in addition, has a very considerable population, at least 15,000,000, the bulk of whom are Indians, who are good agriculturists and greatly superior in industry to the American negro. Wages are low, the average farm labourer earning from 1*s.* 6*d.* to 2*s.* 6*d.* per day.

The reason why Mexico is so disappointing is largely misgovernment. The steady material progress which General Diaz, during his long dictatorship, had brought to Mexico, ended with the overthrow of his government, since which time the country has been racked with civil war, and large parts given over to what are nothing less than brigands. Under these circumstances, it is natural that no progress has been made in the growth of a crop like cotton, which required security for its growers from the depredations of marauders. The principal type of cotton grown corresponds with Upland American. The staple is strong, and the average length is about 1 inch, but there is no doubt that it could be considerably improved. The American long-staple variety, known as Durango, came originally from a province in Mexico of that name. More than half the Mexican crop, i.e. about 100,000 bales, is at present produced in the Laguna district in the North, which includes portions of the States of Durango, Coahuila and Chihuahua. The bulk of this is grown on irrigated soil, and the average quantity produced is about 250 lb. per acre. At present, very little is done to control the waters of the Nazas River, and although plans had been made for a comprehensive system of irrigation, the collapse of General Diaz led to the complete abandonment of the scheme.

Egyptian cotton has also been grown successfully at Monterry, in Nuovo Leon. The larger estates have their own gins and the seed is crushed in local factories. The bulk of the crop is taken up by the local mills, both those in Laguna itself and also elsewhere, as at Mexico City. In fact, very little cotton is exported, and a certain amount of American cotton is imported, despite the fact that there is a heavy duty on imported cotton.

There seems no doubt that if only a settled Government were established, the crop could easily be increased to 1,000,000 bales.

In Central America the completion of the Panama Canal has completely altered the position of the various small Latin Republics, and has brought them out of the backwater into the full current of trade. Nicaragua is at present the State which has made the most efforts with regard to cotton, but beyond the export of 300 bales in 1910 little information is at hand. As in Mexico, cotton is grown in small quantities in most of these States. Guatemala produces quite a fair amount, but with all these areas, before any real progress can be made, a thoroughly stable government and more adequate transport facilities must be established before they can take their rightful place among the cotton-producing areas of the world. Even in British Honduras, where a good stable government exists, although efforts have been made to grow cotton, they have met with little success. This was partly due to insect pests, but perhaps the main cause was the fact that the banana industry already engaged the attention of most of the employers of labour and absorbed the bulk of the labour supply of the district, and this fact may also retard the development of cotton growing in other areas. The proximity of the United States and the increasing demand for bananas the world over makes them a very remunerative crop, and the amount of labour entailed in growing them is certainly less than that necessary for the production of good-class cotton.

(C) SOUTH AMERICA

The only two countries in South America which are of any real importance in the world's cotton supply are Brazil and Peru, but it may be well to point out that in one or two other areas apparently a considerable amount of cotton is grown and very little is exported, as practically the whole of the native crop is taken at the mills ; this is particularly true of Columbia and Venezuela. In the British, French and Dutch Guineas there have been small attempts to develop cotton growing, and there is no doubt that considerable areas are suitable ; but in none of these districts has any real progress been made.

BRAZIL

From 1781 to 1800 Brazilian cotton was the chief source of the Lancashire cotton supply. After that date it began to decline, and although the American Civil War caused a boom in it, the period of low prices in the 90's caused its further decline until its recent revival.

In 1872, 346,231 bales were exported, but since then local cotton factories have increased in numbers, and by 1911 there were 190 of them, and at the present day about 1,000,000 spindles are in use, and these consume the bulk of the crop. This tendency is greatly encouraged by the existence of an import duty of 7·27 cents per lb. on foreign cotton, and in addition most of the separate States of Brazil (which is a Federation) impose export duties on raw cotton of from 8–12 per cent. of its value.

The principal type of cotton which is still exported is a long staple, the short staple being used by the local factories. Cotton growing extends over a very wide area and includes areas offering such different conditions that entirely distinct varieties are grown. For example, in São Paulo three types of cotton are produced, namely Upland in the Southern and

Western districts, various kinds of Egyptian in the Northern districts and Sea Island in the Maritime Zone. The annual output of the State is about 38,000 bales of 500 lb. each. It would appear as if the output per acre was exceedingly high and varies from about 450 to 900 lb. of lint. The principal States growing cotton are Pernambuco, Parahyba, Rio Grande do Norte, São Paulo, Maranhao, Minas Geraes, Sergipe, Bahia, Alagoas and Ceara in that order, and the attached Table (XVI.), prepared by Dr. E. L. Voss for the International Cotton Federation, gives the average for the years 1900–10.

TABLE XVI.

State.	Total Crop.	Home Consumption.	Exports.
Maranhao	32,000	16,000	16,000
Ceara	16,000	8,000	8,000
Rio Grande do Norte	36,200	33,200	3,000
Parahyba	41,000	25,000	16,000
Pernambuco	94,000	58,000	36,000
Alagoas	16,400	8,400	8,000
Sergipe and Bahia	16,800	16,800	—
Minas Geraes	21,200	21,200	—
São Paulo	32,000	32,000	—
Totals	305,600	218,600	87,000

Climate

The climate of Brazil is not entirely satisfactory for cotton growing. Although the rainfall on the Atlantic coast is heavy —over 40 inches per annum in the Interior, whence most of the cotton comes, prolonged droughts are common. The cotton growing season varies considerably in different areas. The planting season begins in the middle of December in some districts and goes on to the end of May in others, and similarly picking extends from July to February. Most of the growers are small farmers, although there are a few large plantations, and a good labour supply is not always obtainable. Political conditions have often militated against the development of the crop owing to lack of confidence by owners of capital in the Government. Wages are low: the highest rate quoted for pickers' wages is only about 1*s.* per 100 lb. of seed cotton, and day wages about 1*s.* 6*d.* But this low rate is not compensated for by low cost of living. Methods of cultivation are primitive, agricultural machinery being almost unknown, and likewise the use of fertilizers, drainage or the scientific rotation of crops.

Varieties Grown

The two chief varieties are the Tree cotton, known as Creoulo or Maranhao cotton, and the other is the ordinary short-stapled herbaceous cotton known as Herbaceo. The Tree cotton or Maranhao is said to yield well for two or three years and to bear open bolls almost all the year round. The lint is of good quality, but the yield is less than that of the herbaceous variety, which, in consequence, is more extensively cultivated. The Tree cotton has the advantage of being more drought-resisting. Its bolls are large, but owing to its close-growing habit, the cotton, when ripe, does not protrude, which causes an increased cost in picking. Its outstanding merit, however, is that it is claimed to be extraordinarily immune from insect pests. Herbaceo is chiefly grown in the coastal areas where the rainfall is more reliable. The staple of both species of cotton varies considerably, ranging from $\frac{3}{4}$ to $1\frac{1}{2}$ inches, but the average is from 1 inch to $1\frac{1}{4}$ inches. Unfortunately the various staples are usually mixed up indiscriminately. In general character the staple is good and possesses a harsh or wiry character which makes it particularly suitable for mixing with wool. The usual weight of a bale is only about 250 lb., although those exported are often more.

Communications

Brazil has remarkably good natural transport facilities, including great rivers that are navigable for a large part of the year, but railway development has been comparatively small, and even so there is plenty of land still unoccupied within the reach of existing railways and rivers. There are in Northern Brazil over 30,000,000 acres available for cotton provided with good communication, either by river or rail, yet less than half a million actually grow cotton.

Prospects

While Brazil could undoubtedly produce far more for export than she does at present, there is no real prospect of her taking her rightful place among the cotton-producing countries of the world. The reasons are, briefly, that capital and, still more, initiative are lacking. The labour supply is poor and methods of cultivation and seed selection exceedingly primitive, so that even the present area does not produce as much as it could. Brazil could probably grow a crop of 20,000,000 bales, but at the present moment she does not produce half a million.

PERU

Peru is the other great cotton area in South America, and the conditions of cultivation and the varieties grown differ almost entirely from those in Brazil. Cotton is grown almost entirely under irrigation, as the climate is practically rainless except in the North where torrential showers sometimes fall in summer. Cotton can be grown on a still more extensive scale than at present if funds were available for carrying out further irrigation works.

The peculiarity of Peru is that it consists mainly of arid sand-hills intersected by numerous valleys running from the Andes to the sea, at each of which is the bed of a river which is filled with a rich, deep, alluvial soil, and in the hottest months, which constitute the cotton-growing season, the volume of these rivers is greatly increased by the melting of snow in the mountains, and as the slope of the valleys is fairly steep, irrigation is a simple matter and every part of the land can be conveniently watered. Owing to the Humboldt current, the temperature is moderated and is fairly uniform throughout the year, the mean average temperature of the coast provinces being 68° F. Indeed, in some parts of the country, the climate is so uniform that sowing can be done at any time of the year, but the usual sowing season is in October or November, and the picking season in May or June. Moreover, as many of the valleys in which the cotton is grown are situated near the coast, the cost of transport is small, railway communications are fairly good, and the only difficulty is the heavy surf which prevails during the cotton harvest season and renders the loading of the steamers somewhat difficult. The cotton estates range from 5,000 acres down to about 500, and are chiefly in local hands.

Labour is usually drawn from the native Indians, who are on the whole fairly efficient, but there is a shortage and wages are high, about 2*s.* 6*d.* per day. Attempts to supply the shortage of labour by the importation of Chinese and Japanese labourers have not been very satisfactory. Some of the larger estates let out part of their land to natives as small holdings on a crop-sharing basis, which is said to give better results than ordinary wage labour, as workmen look after their own crops with greater care than they do after the crops of an employer.

Methods of cultivation are somewhat primitive owing to lack of capital, but because of the close proximity of guano deposits, a fairly extensive use of this fertilizer has been established. The larger estates usually have their own ginning plant, and these also gin and press the cotton of the small farms in exchange for the cotton seed, which is worth about £5 per ton. A few of the ginneries also crush the seed, and there is a local industry which utilizes the oil.

Varieties

There are four chief varieties cultivated in Brazil :—

(1) Smooth Peruvian, which constitutes about 65 per cent. of the crop. The staple is about 1¼ inches, is strong and a good colour, and a good fair cotton of this variety usually obtains a premium in Liverpool of 60 to 80 points on American Middling. It is usually grown as a biennial crop, the average yield per acre for the first year being about 500 lb. and for the second 350, which latter is sufficient to cover the small cost of cultivation in the second year. The ginning outturn is 31 per cent.

(2) Rough Peruvian constitutes about 30 per cent. of the total crop. It is an indigenous plant (*G. Peruvianum*) and

comes mostly from the Northern valleys. It is a perennial cotton growing to a height of 8 or even 10 feet, and will live as long as twenty years, but is usually replanted after the fourth crop. There is always cotton ready to be picked from this variety, but the principal seasons are June to October and December to March. The staple is long, being 1¼ to 1½ inches, and, like Brazilian, it is used largely for mixing with wool. The price of good fair cotton of this type is generally 1*d.* to 1¼*d.* above American Middling.

(3) Sea Island cotton of an inferior quality is grown in small quantities, but its price is generally below that of Georgia cotton. It is believed that the quality could be considerably improved, but in any case the possibility of real success with Sea Island is probably limited to districts near the sea.

(4) Peruvian Afifi is a comparatively recent acclimatization of Egyptian Mitafifi cotton from imported seed. It has met with considerable success and commands a price equal to the Sea Island type of Peruvian. The price in Liverpool of good fair Peruvian Afifi has sometimes been nearly 1*d.* higher than the same grade of Egyptian.

Pests

Cotton in Peru has so far been remarkably free from pests, though in recent years an insect known as *Piojo blanco* has appeared among the Rough Peruvian tree cotton and done considerable damage.

The best method for dealing with this pest appears to be more frequent replanting of the trees. The experience in Brazil and Peru is in direct opposition, so far as tree cottons are concerned, with those of India and Egypt, and whereas in the former they appear to be little affected by pests, in Egypt, India and Africa tree cottons have been found specially subject to insect pests.

Prospects

There appears to be no doubt that a considerable expansion of the cotton industry will take place in Peru. There are still miles of acres of excellent land in the coastal valleys capable of being brought under cotton cultivation if properly irrigated.

The water supply is ample, and only capital is required to meet the first cost of construction of irrigation works. Competent experts believe that, if developed on these lines, Peru in the course of a few years would yield as large a crop as Egypt, and of an excellent quality. Peru certainly deserves the special attention of fine cotton spinners throughout the world.

Quantities

The quantity of Peruvian cotton has increased greatly in recent years. In 1899 the exports were 26,000 bales of 500 lb. each (the actual Peruvian bale is about 250 lb.), but by 1909 the exports had increased to 96,000 bales. About 90 per cent. of the crop is exported, the local consumption being small. Statistics for this area showing the actual amount grown are not very reliable, but the yield is said to average about 500 lb. of lint per acre on the better plantations, which is as good as the Egyptian average, and under ideal conditions this total has been doubled. The Peruvian Government has taken a keen interest in the improvement of the crop and has established an experimental station near Lima. The planters are also described as intelligent, progressive and eager to utilize the latest information as to cotton growing.

THE ARGENTINE

Whereas the possibility of cotton growing in the Argentine Republic are enormous, the development of these possibilities is slow, chiefly on account of lack of sufficient labour. In the Northern areas, particularly in the Chaco Territory, a considerable amount of cotton has already been grown by European planters, who employ native Indian labour. Methods of cultivation, and particularly of picking and handling, are very primitive, and these reduce the value of the samples which were shown in 1914 at the International Congress of Tropical Agriculture in London. The principal varieties grown are three :—

(1) American.
(2) Peruvian.
(3) Egyptian.

The yield would appear to be high, the Egyptian cotton being about 500 lb. of lint per acre ; but the total crop all told hardly exceeds 5,000 bales. The great difficulty here, as in most of America, is the shortage of labour, and the fact that the Argentine already produces many other profitable crops tends to keep labour from entering cotton cultivation.

Paraguay also has the same potentialities, rendered abortive by lack of initiative and shortage of labour.

Uruguay in 1913 produced, 10000 bales, and appears likely to produce considerably more in the near future.

Chile also grows a similar quality of cotton. About 1,000 bales are reported, but there are no signs of any rapid development in that country.

(D) FOREIGN AREAS IN AFRICA

Former German Colonies.—It has already been pointed out in the British Section that a certain amount of cotton can be produced in Togoland, the Kameroons, the former German South-West and German East Africa. The total production of Togoland in 1913 was some 2,200 bales of 550 lb. Owing to the rivalry of the palm oil crop, which is much more profitable and needs less care, it is not probable that any very considerable increase will take place in the total output. Togoland, it will be remembered, is divided between England and France, and according to the latest information it is the Southern part, which contains the railway and is by far the most valuable section, which has been handed over to the French.

The Kameroons are potentially a good cotton area, but labour and transport difficulties have so far prevented any great output. The bulk of the Kameroons is the possession of France, only a narrow strip along the borders of Nigeria and a somewhat larger portion towards Lake Chad having passed under British control. In pre-war days the output was trifling. *German South-West Africa* has already been dealt with under British South Africa, of which it now forms a part. Except in the Northern area, it is not likely to produce any considerable amount. German East Africa has similarly passed to England, with the exception of one or two border districts near the Congo and Portuguese East Africa. In this area the total quantity produced is fairly considerable, 8,768 bales of 550 lb. being the figure for 1913.

The French Colonies in Africa are, first of all, North-West Africa, where the Hinterland and Sahara Desert belong to the French, and the coastal areas are Algeria and Tunis on the Mediterranean, Senegal and French Gambia, the Ivory Coast, the French Congo, etc. On the East coast the Islands of Madagascar and Reunion and the French Somaliland are the only places of importance.

The West African possessions, which now include half Togoland and almost all of the Kameroons, are by far the most important. Their development is dependent on the increase of the mileage of the railways. At present these are in a somewhat rudimentary state, but nevertheless at least 1,500 miles exist and they already pay their way. The French Colonial Cotton Association has devoted considerable attention to the development of cotton growing. In Algeria considerable success has been achieved with American and Egyptian cotton in various districts. In Tunis, however, the limit of extension has been reached and the total amount is trifling. This is due to the lack of an adequate water supply. In Madagascar and Reunion the total output is insignificant, and indeed the matter is only in an experimental stage. The following figures in bales of 500 lb. give the total production of cotton in 1913 for the various areas in Africa for comparative purposes :—

Total British, excluding Egypt, but including the Sudan	50,184
German	11,859
French (all areas)	1,944
Portuguese	2,817
Italian, estimated at about	880
Grand total for Africa	67,684

The Italian possessions in Africa are Eritrea with its port of Massowa, Italian Somaliland along the Juba River and Tripoli. Of these only Eritrea has produced any considerable quantity of cotton. The quality grown here is exceedingly good. The type grown is American, but it has been improved from 1⅛ to 1¾ inches long and is very fine and silky. The cotton is often called carcavat, and Italian spinners are said to use it for counts as high as 80's, and in pre-war days consignments sent to Liverpool averaged 2*d*. above the price of American Middlings. The crop seems to fluctuate considerably. The largest crop was that of 1911–12 with about 4,873 bales of 500 lb., but in 1913 only about 880 was produced. There are considerable areas which might be brought under cultivation in time, particularly if the transport difficulties can be surmounted. In the Italian Somaliland, along the Juba River Valley there is suitable land for growing cotton under irrigation, but as yet a sufficiently stable and organized Government has not been established, and until that is done the native cultivators cannot be expected to devote themselves to the industry, with the certainty of being raided from time to time by the wild tribes of the Hinterland. Tripoli ought to be capable of growing cotton under irrigation, but as yet practically nothing has been done.

Portugal possesses two important Colonies, Angola on the West coast and East Africa, including Portuguese Nyasa. The Government has been doing everything it could to extend the cultivation of cotton, and the cotton grown is mostly American Upland, and is generally superior to the Middling Upland. Caravanica has proved somewhat of a failure, but Peruvian and several native tree cottons have been fairly successful. It is stated that American Upland, if treated as a perennial crop, is better in the second year than the first. Lack of transport facilities naturally retard development, and the total output in 1913 was only 761 bales of 500 lb. In Portuguese East Africa the Nyasa Company has succeeded in growing a good type of Egyptian cotton, but the Mozambique Company has not been so successful owing to the lack of irrigation facilities. American long-staple cottons seem to be generally successful, and the tendency is towards growing that type only. At Bompuna the Zambesi Company, after experimenting with Egyptian seed in 1904, abandoned this variety and in 1910 planted Nyasaland Upland with much greater success, in 1913 crops in this district alone being 650 bales. The total crop for that year for all Portuguese East Africa was 2,056 bales.

In Portuguese Guinea efforts have been made to grow cotton, but so far the output is trifling.

The Belgian Congo has an area of nearly 1,000,000 square miles, the larger part of which should be capable of producing cotton. Experiments have been made in different parts of the area, particularly in the Lower Congo near the sea and in the Upper Congo, where success has been prevented by lack of transport. Several types of cotton have been tried, including Egyptian, Sea Island and Upland, but the most hopeful results have been obtained from a native cotton. Up to the outbreak of the War the yield barely covered the expenditure of the Government in promoting the industry, and it seems certain that the only satisfactory method of growing the crop is by the native cultivators, European planters finding it impossible to obtain a sufficient labour supply.

In 1913 a new series of experiments were begun with the assistance of the British Cotton Growers' Association, and it is believed that important results may accrue. At present, however, the total output is negligible. The Congo has one great advantage, namely, it has fully 6,800 miles of navigable river. Rapids and other barriers on this river have been surmounted to a certain extent by means of loop railway lines.*

Briefly we may summarize the position of the whole of Africa as follows :—

Not quite 70,000 bales of 500 lb. were obtained from the whole of Africa, excluding Egypt, in 1913. While the total result of ten years' labour may appear somewhat small, really the results have been fairly satisfactory. It has established the fact that cotton can be grown in considerable areas in Africa, and further has shown on what areas it is best to concentrate attention. It should be noted that, for the most part, these areas are within the British Empire, the only non-British areas which showed any great prospects being the German Colonies, particularly East Africa, which has now passed under our control. For the rest it is quite possible that France and Italy may in time be able to produce an appreciable amount, but that will not be immediately. All credit should be given to the British Association for their strenuous labours, and the thanks of all cotton users, not merely manufacturers but "the man in the street" who wears cotton clothing, should be registered for their efforts. It would, however, be a mistake to expect too much in the near future. As has already been indicated, the immediate prospects of any large total increase to the world's supply from Africa are problematical.

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* M. Edm. Leplae in his paper at Zurich (1920) shows that steady progress has been made, the total output for 1919 being 600 to 800 tons.

(E) NON-BRITISH ASIA

The principal cotton-growing areas in Asia fall into two main divisions, Western and North-western Asia and Eastern and South-eastern. Under the former headings are Russia, Persia and Asia Minor. For the sake of convenience, the little cotton grown in European Russia is here considered along with the production of Asiatic Russia. The Eastern and South-eastern portion of Asia includes China, Japan and Indo-China. Taking the Western area first, let us consider—

RUSSIA

At the present moment the chaotic conditions prevailing in that once powerful Empire renders it difficult to know how far we can in the near future depend upon Russia as a source of cotton supply. The best that we can do at this moment is to summarize what the position was before the outbreak of war and to bear in mind that what Russia did then she could, under happier conditions, exceed to-morrow.

The main supply of Russian cotton was utilized in local mills since 1900, and although the consumption of cotton in Russia had increased by 1914 by fully 50 per cent., the imports of foreign grown cotton had hardly gone up at all. The total amount of crop available was estimated by many authorities at about 1,000,000 bales of 500 lb. each, but according to the International Federation statistics for the year ended August 31, 1913, much more than this was consumed in the Russian mills. These figures indicate that 7,130,843 spindles out of an estimated total of 9,212,557 consumed 1,481,778 bales of "sundries," that is to say cotton other than American, Indian and Egyptian, and which we may assume therefore was entirely Russian. It must always be remembered that in Russia the statistics are by no means reliable at the best of times, and large quantities of cotton were taken for domestic consumption which never appeared on any official returns.

The native cotton is a rough staple about $\frac{9}{10}$ths of an inch in length and very similar to the Indian cotton, and, like the Indian Wagad variety, the bolls do not open sufficiently to allow the cotton to be pulled out, so that in picking the crop the bolls have to be broken off and the cotton extracted afterwards. This has its advantages, as it protects the cotton being damaged by rain or frost in the autumn.

The cotton famine caused by the American Civil War led to attempts to increase the cultivation of cotton and to introduce foreign varieties. Sea Island seed, which was the first variety tried, proved unsuitable as the climate was too dry. Later experiments with American Upland seed proved successful. It soon became acclimatized and the principal crop on account of its superior quality and high yield.

The development of cotton growing in Russia was fostered by the high import duty, nearly 3*d.* per lb. being charged on imported cotton. This burden on the consumers has undoubtedly tended to check the development of the cotton industry in Russia, as even in 1914 quite 500,000 bales per annum of foreign cotton had to be imported. On the other hand, the growers gained, but it is doubtful whether, in the long run, the actual growers reaped much material benefit, as the principal result was high rents, often as much as £6 per acre, and high interest charged by the moneylenders, namely 5–12 per cent. per month. As the small growers were largely in the hands of the moneylenders, it can be readily understood that they themselves gained little advantage from the high prices they could obtain for their cotton.

The two principal areas in the Russian Empire devoted to cotton growing are Russian Turkestan and Trans-Caucasia. These are the most Northerly cotton-growing areas in the world, being 5° further North than the limits of cotton-growing plantations in the States, and much further from the equator than any country at present growing cotton in the Southern Hemisphere. The possible extent of cotton-growing land in Turkestan is stated to be 200,000 square miles, but, as in Egypt, only a very small part of the area is at present cultivated at all, namely some 5,000,000 acres, and of these barely one-third in 1914 was actually employed for the growing of cotton, so that the cotton-growing area itself did not exceed 1,250,000 acres.

High Yield

The yield is comparatively high, being, as a rule, 300 lb. of lint per acre, while in the best districts 450 lb. are generally obtained. These figures are excelled only in Egypt, and in many ways the Russian crop shows similar conditions to those prevailing in Egypt. Both produce about 1,000,000 bales per annum.

Climate

The climates in Turkestan and Trans-Caucasia are very similar, and the following description, based on Turkestan, may be considered as applying equally to Trans-Caucasia. The rainfall in Turkestan ranges from about 6 inches per annum in the Syr Darya District to 16 inches in Samarkand. Evaporation is very heavy owing to the great summer heat, and cotton growing is only possible under irrigation, which is supplied by a number of rivers flowing from the mountains into the plains. Irrigation was introduced by the Chinese in the first century of the Christian Era and some of the old works are still in existence, and might, it is believed, be repaired or made the basis of a new scheme, and the Russian Government had plans for an extensive engineering scheme which would have nearly doubled the area available for cotton cultivation.

Labour Supply

One outstanding difficulty is, however, the shortage of labour. Turkestan only became Russian some fifty years ago, and at the outbreak of the War had only an average of eight inhabitants per square mile. The indigenous population consists of a mixture of almost every race to be found in Central Asia, and most of them in religion were Mohammedans who regard the Russians as alien conquerors, and, furthermore, if the population were increased by immigration, it would be necessary to develop communications between Turkestan and the wheat-growing areas of Russia so as to provide the necessary food for the increased population.

Soil

The soil in Turkestan is clayey and suitable for irrigation work, as it is not easily permeable by water and is yet firm when moist. It is also rich, its fertility being increased by alluvial deposits from the rivers.

Cotton Season

The cotton season starts with the planting of the seed in March or April ; picking begins in August and ends with the arrival of the frost in October ; hence early maturing varieties of cotton are essential. The land is divided up, as a rule, into small holdings held by peasant farmers who own or hire it under various systems of profit sharing. They are almost ideal agricultural labourers, but greatly handicapped by their lack of capital. Hand labour is employed almost entirely and wages are comparatively high, as much as 5*s*. per day, having risen 100 per cent. during the last ten to fifteen years.

Cultivation

Fields are laid out in ridges and furrows, the latter connected in a zigzag fashion so as to carry the irrigation water over the whole area. The seed is sown after watering (unlike Egypt), twenty to thirty seeds being put into each hole. On thinning out, three plants are left in each hole. About five waterings are given each summer, but if too much water is given the soil becomes hard and interferes with the proper growth of the plant. There is another method of planting in practice : the cotton is sown in flat ridges with parallel furrows only. After the plant is up, new transverse furrows are cut so that each plant becomes a centre of a little island surrounded by the irrigation water at every flooding.

The Garmsil

The Garmsil or hot North and North-easterly winds sweep over the desert in summer and often destroy the plant by drying it up. They also damage the ripe cotton by blowing dust into the boll. These hot winds are most frequent in very dry seasons, and it is said that they are responsible for the loss of as much as half or one-third of the crop in a bad year. This is the most serious difficulty with which cotton growers of Turkestan have had to contend.

Ginning and Baling

The cotton is ginned and pressed at local ginneries into bales of some 250 lb., with a density of about 24 lb., but in recent years the ginneries have begun to put up bales of 500 lb. with a density of slightly over 30 lb. The ginning outturn is low as a rule, being only 28 to 30 per cent.

The Upper Sub-areas

Turkestan was divided into five administrative divisions, of which four were important cotton-growing centres, and in addition there were the two tributary States of Bokhara and Khiva.

1. **Ferghana.**—This is a long valley bordered on three sides by high mountains, and the only entrance is through a narrow pass in the West. The climate is hot in summer and mild in winter, and the land is irrigated by canals from the Syr Darya River, which rises in the Tianshan Mountains, East of Ferghana. This province produces a half of the whole Russian crop, the variety grown being an American type, having an excellent white colour and a strong, silky staple of about $1\frac{1}{8}$ inches in length which ranges between "fully" middling and "good" middling. The area under cultivation in 1914 was about 700,000 acres, having a yield of some 500,000 bales of 500 lb. each. There are also large areas which, if irrigated, would produce considerable quantities of cotton.

2. **Syr Darya.**—The Syr Darya district lies to the North-west of Ferghana and occupies the lower reaches of the river, which empties into the Sea of Aral at its Northern end. The cotton area here is about 150,000 acres with a yield of 80,000 bales. The chief town of the province is Tashkent.

3. **Samarkand.**—The Samarkand district is irrigated from the Serafschan River, said to be a tributary of Amu Darya, which also finds its way into the Sea of Aral at its Southern end,

forming a huge delta. This area, which should produce large quantities of cotton, falls far short of the first two districts mentioned, owing to the destruction wrought by locusts. The other crops, such as rice, can be protected from these pests by flooding the fields, but this is impossible in the case of cotton, and the tendency therefore is for the cultivators to devote most of their energy to crops other than cotton. The variety of cotton grown here is generally American, but its quality has been lowered by mixing with native types which are often found growing side by side with the better grade varieties.

4. **The Trans-Caspian District.**—This area obtains its water from the Amu Darya (the classical Oxus) and from the Murgab rivers. The latter is one of those strange Central Asian rivers which never reach the sea. Starting from the mountains of Afghanistan, it disappears into the desert a little North of Merv. The importance of this river is that on it were situated the Imperial estates, which were magnificently laid out and produced very fine cotton, but elsewhere the quality of the crop has suffered by mixing with the native varieties.

5. **Bokhara.**—Bokhara, which lies between Samarkand and Trans-Caspia, is watered by the Serafschan and the Amu Darya rivers, but only native cotton is grown. There is a peculiar reason for this condition of affairs : the land tax is charged according to the yield of the crop, and the latter may not be removed from the field until the revenue officer has seen it and assessed the value of the cotton. The native variety with its closed bolls is the only type which can resist damage by weather during the delay which inevitably occurs. In pre-war days the output amounted to 75,000 bales.

6. **Khiva.**—Khiva is North-west of Bokhara and on the lower reaches of the Amu Darya. A very good grade of American cotton is grown there which fetches higher prices in Moscow than the Ferghana variety. Native cotton is also grown in this part, and the total yield is estimated at about 50,000 bales.

Communications

Turkestan is comparatively well supplied with railway communications. Starting from Krasnovodsk on the Eastern shore of the Caspian Sea opposite Baku, the line runs South-east through the Trans-Caspian Province to Merv. Hence a branch runs South to the Russian border near Herat in Afghanistan. From Merv a second line runs northward again through the Karakum Desert across the Amu Darya River along the course of the Serafschan River through Bokhara, and so on to Samarkand. After crossing the mountains, a branch turns Northward through Tashkent, follows the course of the Syr Darya River, passes the North end of the Sea of Aral and finally joins the Trans-Siberian line on the Volga, thus connecting the Turkestan railways with the main Russian system. The other branch continues Eastward along the Syr Darya towards its source through Ferghana, passes Kokhand, the chief cotton centre of the province, and terminates at Andijan.

TRANS-CAUCASIA

Trans-Caucasia, although nominally considered as part of Russia-in-Europe, is really Asiatic both in climate and civilization, and the principal difference between it and Turkestan is that the rainfall is considerably heavier. The cotton-growing areas of the province are to the South of the Caucasian Range and the valleys of several rivers which flow East to the Caspian or West to the Black Sea. In addition, cotton was being grown in the Valley of Erivan within sight of the traditional landing-place of the Ark in Mount Ararat. The largest area is in the valley of the River Kura, which rises near Kars, passes through Tiflis and falls into the Caspian Sea near Baku. Another important district is in the province of Kutais on the River Rion, which runs Westward and falls into the Black Sea at Koti, a little way North of Batum.

Communications

These districts are comparatively well supplied with railways. The main Southern line from Moscow to the East of Azof at Rostov is continued Southward to the foot of the Caucasian Range at Vladikavkas. Just before the War there was a project afoot to carry it across the mountains to Tiflis, but when, if ever, this proposal will now be carried out, it is impossible to say. Meanwhile the line turns Eastward to the

Caspian shore, which it follows as far as Baku. Thence another line goes Westward up the Kura River Valley through Tiflis and Kutais, Depoti and Batum. From Tiflis another branch runs Southward to Kars and Erivan. The total area under cultivation in this district in 1912 was said to be 320,000 acres, which could have been increased to over 1,000,000 acres if irrigation works were carried out. The actual crop was 125,000 bales, which could by irrigation have been increased to fully 500,000. American varieties have for many years been grown side by side with native types of cotton, with the inevitable result of the deterioration of the higher grade quality. In 1912 the Russian Government convened a congress of cotton growers at Tiflis under the auspices of the Caucasian Cotton Association. A series of far-reaching proposals were made for the improvement of existing conditions. These included an irrigation scheme and the substitution of cotton for certain summer cereal crops, an increase in the system of gratuities to cotton planters and the establishment of experimental cotton farms. Nothing definite, however, had materialized when the War put an end to all such schemes.

Summary

To sum up the general situation in Russia, we may say that in pre-war days Russia used, roughly, to produce about one-and-a-half million bales of cotton and, with a proper system of irrigation and more scientific methods of cultivation, would probably have produced sufficient raw cotton for her own mills, thus enabling the quantity of foreign cotton which was imported to be diverted to other countries who are unable themselves to produce this important raw material. At the present moment it is utterly impossible to say what the position is. The production of cotton goods has undoubtedly fallen, probably to vanishing point, owing to the disorganization throughout the whole of European Russia, due to the revolution ; but whether the cotton-growing areas will be able to continue to grow their cotton and send it to foreign countries who will be glad to receive it is questionable. Undoubtedly, however, these areas are at present enjoying a less unstable political condition than European Russia, and it is possible that enterprising cotton buyers might find it worth their while to open up communications via Persia or India with the cotton growers in Turkestan and Caucasia.

PERSIA

In the Northern half of Persia, where a considerable amount of cotton is grown, amounting in the aggregate to some 140,000 bales, the cotton is usually of an inferior native variety, similar to Russian cotton, and has a type of boll which opens badly, while the lint contains a good deal of leaf. Nothing has been done to develop the growing of improved types on a commercial scale. The rainfall in the interior is only about 5 inches in the year, and there is no adequate irrigation system. In the immediate neighbourhood of rivers, where cotton can well be grown, the land is usually taken up with rice. The crop formerly went almost entirely to Russia, and now that this market has failed there seems an opportunity for some energetic group to arrange for its transport to India ; but in Persia transport is particularly bad, and it is probable at the present time that much of the cotton is going to waste. In former days almost the whole commercial crop passed through the ports of Enzeli near Resht in the province of Gilan, through Meshedisar in Mazanderan and Bender Gez in Astarabad. The cotton is brought down from the interior to these ports in small bales of about 200–270 lb. In the present state of anarchy in which Persia has collapsed no considerable increase is possible, and until adequate methods of transport are adopted the one market now available, namely India, is practically closed. It cannot be said, therefore, that the prospects for the Persian cotton is very hopeful. Nevertheless it is worth noting that in 1912–13 the total value of the Persian exports was £1,706,246, of which £1,683,000 went to Russia.

ASIA MINOR

The development of cotton growing in Asia Minor was largely the work of the German Levantine Cotton Co., which was a commercial undertaking registered in 1904, paid a dividend and claimed no Government assistance. It adopted a far-sighted policy, and the methods employed have been to develop cotton growing in certain selected areas by the importation and distribution of good seed, by working gins and presses, and by financial assistance to small farmers who adopted up-to-date methods of cultivation.

The first area developed was Adana in the North-eastern corner of Asia Minor. The climate and soil were suitable and the Port of Mersina provided the necessary place for the collection and export of the crop. The area here available for cotton is very large indeed. The soil is mostly alluvial, and the geographical character of the province of Adana rather resembles that of the Nile Valley. For the full development of the province a complete system of canal irrigation appears necessary, but up to the outbreak of the War this was impossible. The insensate policy of the Turks in massacring the Armenians, who were the best cotton growers, has further militated against complete success. Particularly in 1909 the slaughter of the bulk of the male Armenians deprived the area of the necessary labour. The climate has a somewhat heavier rainfall than Lower Egypt, being about 25 inches, and the soil is of a clayey character and retains moisture for a long time. The most serious disadvantage is the hot winds in the early autumn, which cause boll shedding. Large plantations under European control were impossible owing to the shortage of labour, and therefore the Company adopted the policy of encouraging small holdings.

The native cotton is known as *Yerli* and is similar to that grown in Russian Turkestan. The cotton boll is picked from the plant and the seed extracted afterwards. The whole crop matures at once, and therefore this method, which enables picking to be rapid, has much to commend it. The efforts of the Company to grow American cotton have been hindered by the fact that the actual picking requires more labour. Nevertheless American cotton being more productive and a better staple would be a more remunerative crop. For this reason the Company persisted in its efforts.

Experiments have also been made with *Ferghani* seed from Russia which gave good results, and the cotton produced from both American and Russian types realize prices quite equal to Middling American. The cotton has a staple of about 1 inch and is described as white and glossy. The gin employed is the Egyptian roller gin and not the American saw gin, and the bale is similar to the Egyptian but only half the weight.

Another area in which development was begun before the War is Aidin, where good Egyptian cotton could be grown, and much irrigable land is available. Prospects here before the War were most promising owing to the fact that the vine crops in the upper part of the valley have of late years become unremunerative for various reasons, and this has encouraged the natives to take up cotton, while the proximity of the important port of Smyrna renders the transport of the cotton fairly easy.

Round Aleppo a certain amount of cotton is also grown, but no great progress has been made, and the principal difficulty seems to be caused by locusts which at times descend in large quantities and destroy practically the total crop. Just previous to the War the total production of Asia Minor was as follows :—

In bales of 440 lb., 1913–14	Aidin . . .	30,000
	Adana . . .	100,000

From Aleppo in 1912 some 2,515 bales were exported, but in 1907, 18,000 had been exported. The bulk of the crop went to Austria, Italy, Spain, Germany and France, Austria alone taking quite half. One or two factories have been established at Adana and Tarsus which use about one-third of the whole output. In the Jordan Valley and Syria generally, cotton cultivation has been carried on for many years, but only on a small scale; there is, however, every reason to believe that now that a more settled form of Government has been established in these districts considerable progress may be made. The great obstacle in former days was the total lack of security which rendered it unwise for a small man, particularly a Christian, to amass any considerable amount of money. Now that this danger has passed away, Europe may reasonably hope for quite an appreciable increase in medium and low grade cotton from these areas.

Perhaps some parallel may be drawn from Greece, where the Plains of Bœotia produced an average output of 22,000 bales of 500 lb., all of which was used in local mills. Some of this was Egyptian cotton, and in Salonika a considerable amount of cotton is also grown, the crop for 1911 being fully 5,000 bales of 500 lb. of American and 2,240 bales of native cotton. Trifling quantities have also come from other contiguous areas such as Cyprus, which now appears to have passed permanently under British rule, who during recent years has increased her crop from one to seven thousend bales and could probably produce still more and a better quality, namely long-staple American, if irrigation were introduced.

The only other area in the Empire of Turkey which is deserving of consideration is Mesopotamia. The possibilities there for cotton growing are believed to be unlimited, and now that it has passed under English control and a beginning has already been made with irrigation, there seems no good reason why in a few years a very substantial crop of cotton should not be obtainable from the valleys of the Tigris and the Euphrates. As yet, however, figures are naturally unobtainable.

Briefly it may be said that of all the areas in Asia almost the only one which promises any substantial increase to the total stock of cotton available for the European factories is the former Turkish Empire, and in view of the fact that large areas have undoubtedly passed into the hands of the British Empire it is to be hoped that adequate steps will be taken to encourage the growth of this essential raw material.

CHINA, INDO-CHINA AND JAPAN

(i) China

Cotton cultivation is spreading very rapidly throughout the whole of China, but the bulk of it is absorbed in domestic consumption. Of the total, probably 1,850,000 bales per annum are thus absorbed locally. Even for the commercial crop and the exports, statistics are unreliable. "The American Bureau of the Census in cotton produce in 1913" states that the commercial output is about 1,200,000 bales of 500 lb. each, but other authorities consider it as much lower. Nevertheless, after weighing up the various conflicting statements it would appear that from 4 to 5 million bales probably really represented the total crop in pre-war days, including both local consumption and exports. Local manufactures of cotton are increasing steadily, and during the war considerable progress has been made. In 1913 there were at least a million spindles in regular use, and to-day the number is undoubtedly greater. The total number of looms in 1915 was 4,564, and 1,762 looms were under construction. The consumption of cotton for these mills in 1915 was about 266,666,600 lb., or approximately 533,333 bales of 500 lb. each. Total yarn production, including that used by the mills for weaving, is from 220 million to 250 million lb. annually, and the total cloth woven is from 40 to 50 million yards. The principal yarns spun are 10's and 20's. The tendency among the mills is towards the production of a wider range of fabrics. The following figures show the rapid strides that the industry has made in recent years in China.

The value of the export of yarn from Shanghai in 1914 was in American, $13,112,899 ; Grey sheetings, etc., $1,264,822 ; Drills, etc., $567,362. There were also exports from other ports, such as Hankow, and there are no reliable figures for the goods used locally. Of these goods, practically all were sent by coasting vessels to other parts of China, very little being sent abroad, Hong Kong being almost the only place outside China to receive any quantity. Nor do these figures give any indication of what is used on hand looms in the village industries.

It will therefore be seen that although the increase in the growth of cotton in China is important and is likely to continue, yet it is doubtful whether much of this cotton will come into the general world's pool of cotton.

Despite the fact that China is growing more cotton, her imports have also vastly increased, and it is therefore a matter for satisfaction that she is tending to produce more and more locally.

The following table shows the quantity and sources of the imports of raw cotton into China in 1913 in pounds :—

Great Britain	400 lb.
Hong Kong	1,210,800 ,,
India	11,089,200 ,,
Japan	2,028,533 ,,
U.S.A.	3,508,000 ,,
Other Countries	781,600 ,,
Gross Total	18,618,533 lb.

It should be noted that in the previous year (1912) the total imports were 39,059,333 lb.

The imports of cotton from Hong Kong consist really, for the most part, of American and Indian cotton, while the imports from England and Japan were large American. In 1913 the Chinese mills consumed about 200 million lb. of cotton.

It will, therefore, be seen that the imports of cotton are comparatively insignificant, although it is probable that the actual imports both of Indian and American cotton were considerably higher than that stated.

Production of Cotton in China

Cotton is cultivated in almost every part of China, but chiefly in the central and northern sections. The provinces of Kiang-Su and Chingkiang in the Yangtze Valley, near Shanghai, produce the best quality and the largest amount. Other important provinces are Hupeh, Hunan, Honan, Shensi, Kiangsi, Chihli and Shantung, also in a separate area in Western China near Burma, particularly in the province of Yunnan.

Tientsin, Hankow and Shanghai are the chief markets to which cotton is brought for sale. The total amount of cotton exported in 1913 was 127,110,533 lb., but a considerable amount of this cotton was only shipped from one Chinese port to another. The average price per lb. in 1913 was about 6¼*d.*

The cotton grown in Northern China, which is chiefly shipped from Tientsin, is of two kinds. The larger quantity comes from the province of Chihli and is known as "Hsiho." It closely resembles Peruvian cotton, and is of good colour, but is short and wiry, and not suitable for spinning cotton yarn. It largely goes to Japan for use in stuffing kimonas and other garments, and to the United States where it is mixed with wool in the manufacture of blankets. It seems to serve excellently for this purpose, and the United States buys nearly 20,000 bales annually.

In the Shantung province, north of Tientsin, a better grade of cotton known as "Yuho" is produced, and finds a good market in Japan and Shanghai. It is suitable for spinning low counts. The principal disadvantage which Northern China labours under in cotton cultivation is that the seasons are shorter and frost earlier, and the soil is not so rich as in the Yangtze Valley. The export of cotton from Tientsin has increased enormously in the last few years, whereas in 1908 only 509,867 lb. were shipped to foreign countries and Chinese ports. In 1913, 44,851,200 lb. were exported.

The substitution of the cotton plant for opium cultivation since the prohibition of opium has been one of the principal factors in encouraging the growth of cotton in this area. In Central China cotton is grown largely in the provinces of Honan, Hupeh and Shensi, and it is generally brought to Hankow on the Yangtze River, which is 600 miles from Shanghai, for sale.

There are many qualities of cotton, some of which, being unsuitable for spinning, are shipped to Japan for wadding and stuffing purposes. That grown in the lowlands of the Honan province is strong but short, and is largely used for low counts. The large cotton mill at Wuchang which had 900 spindles and 800 looms in 1915 depends entirely on this type of cotton for its raw material. In 1915 the local price of Hankow cotton ranged from about *3d.* to 3½*d.* per lb. Just before the War Germany, as well as Japan, had begun to take considerable quantities of Hankow cotton. The area under cotton has been steadily increasing, particularly since the disappearance of opium.

Efforts to cultivate American types of cotton in the Yangtze Valley have not been very successful. The cotton does not appear to mature well, and since the bolls open upward instead of downward, as is the case with Chinese cotton, excessive rain causes the cotton to rot in the boll, or fall off. The climate and soil along the Yangtze is, however, well suited to the better types of cotton plant, and what appears to be required is a scientific system of hybridization of the local cotton with suitable American varieties. Along the Yangtze, although there is usually abundant rainfall, the farmers resort to irrigation to safeguard themselves against occasional droughts. It is done very much after the manner following in Egypt ; in some of the richest land 600 lb. of ginned cotton is produced to the acre, but the average is about 200 to 300 lb. The crop is subject to considerable fluctuations however, owing to floods, droughts, and in some districts insects and other pests. A variety of rotations exist, but methods of cultivation are still very primitive, although there is a tendency in many parts to improve them. Planting usually begins in the middle of April and lasts to the middle of May. The first picking starts in the third week in August and continues to the last week in September or the first week in October. The methods of picking vary, but the system of picking the entire boll and later separating the cotton from it is still a practice in many of the interior districts. In others, and those the more advanced, the cotton is plucked from the boll. The Chinese Minister of Agriculture is endeavouring to improve the quality of seed and the methods of cultivation, and has established an Agricultural School in which experiments are constantly being made, in order to find out a variety of American cotton seed that will be suitable for China. Other schools are in prycess of formation.

Ginning, Baling and Selling

In some of the interior districts cotton is still separated from the seed by hand, but in recent years thousands of Japanese hand-gins of the roller type have been imported. These gins are very cheap, being about £2 each, and many of the local farmers have purchased them. In some of the larger centres, such as Shanghai, large steam-ginning plants exist, but for the most part manual power is employed. The average yield of fibre is about 33 per cent., which compares favourably with American cotton and Egyptian Mitafifi.

After ginning, the cotton is packed in bags made of nankeen, a coarse-grade cloth woven on hand looms. The method employed is somewhat primitive, the bag being usually suspended on four stout bamboo poles, and a coolie gets inside the bag and stamps it in as the cotton is put in until the bag is full. It is then bound with native-made hemp rope around the sides and end. In this condition it is carried by coolies or transported on small junks on the rivers and canals to Hankow, Tientsin, or Shanghai. The size of the bags varies considerably, and the weight of ginned cotton is 225 to 250 lb. for the large bags, 160 to 170 lb. for the medium, and 75 to 96 for the smaller.

Despite these primitive methods, the bags generally arrive in fairly good condition. In recent years several large central compressing plants have been set up in Shanghai, Tientsin and Hankow, to which cotton thus native packed is brought and then put into pressed bales. Hydraulic presses of the latest type are employed. The nett weight of cotton in a bale is from 466 to 533 lb., and the size of the bale 10 to 12 cubic feet. Both in compactness and appearance these pressed packed bales compare very favourably with those in other parts of the world.

Methods of Dealing in Cotton

Cotton is brought from the interior to the trading centres and ports, where it is bought by large dealers, either for sale locally or for export. The Japanese are large buyers, as over 70 per cent. of the exports go to Japan. Purchases are made by nett weight. The tare on native bales is about 4 lb. and on pressed bales 14 lb.

Adulteration of Cotton

Formerly the practice of watering the cotton in order to increase the weight was a serious difficulty. This form of fraud became so extensive that in 1895 the Japanese spinners, who were the largest buyers, decided that they would buy only from approved dealers who were associate members of the Japan Cotton Spinners' Association. Testing houses were established in the ports, and all cotton showing an excessive amount of moisture was rejected. Up to this time it was not unusual for cotton to have 20 per cent. to 30 per cent. of moisture.

This evil practice appears to have been largely checked by this drastic action. Another form of adulteration was the mixing of seed cotton with ginned cotton. This not only caused a serious loss in weight, but the mills experienced considerable difficulty in separating the two kinds. One mill, however, produced a special machine for this purpose and was, in consequence, able to buy cotton at lower prices.

From the above account it will be evident that China is tending to become a large cotton-producing country, but in view of the considerable quantities she herself requires and the prospect that she will, in the near future, require still more, it would not be wise to expect a large addition to the supply available for European countries. For the most part, China will have done her share if she supplies her own needs and those of Japan in the near future.

(ii) Indo-China

In French Indo-China no complete figures are available as to the acreage under cotton; neither is there much which will enable us to form any opinion as to its future possibilities, but the export of raw cotton from Saigon alone in 1912 was at least 19,000 bales. The cotton was of good quality, and went mostly to Hong Kong, whence, for the most part, it was re-exported to Japan.

Cotton is also grown in Tongking and Annam, and used to go to China via the Port of Pakhoi, but since 1909 this trade has dwindled, and it seems as if the bulk now goes to Japan.

Siam produces a considerable quantity of short staple native cotton, most of which also goes to Japan. The cotton-growing area is in the valley of the Menam River, and the export is steadily increasing. In 1913 some 5,000 bales were produced. It is grown almost entirely by small cultivators, but the Government owns a ginnery at Pitsanuloke, and supplies free seed which is partly imported from Cambodia. The general methods of cultivation are similar to those of China, that is to say fairly intensive, though primitive, and about 100 lb. of seed cotton per acre is the average yield under good conditions.

(iii) JAPAN

Even before the War, Japan was becoming the most important cotton manufacturing country in the East, and since 1914 she has vastly increased her output of manufactured cottons. She is not, therefore, in a position to supply Europe with cotton. On the contrary she tends more and more to draw from outside areas for the bulk of her supplies. Most of her raw material comes from India and China, while on the other hand her imports of manufactured cotton goods from other countries are decreasing even more quickly than her exports to other countries are increasing. Japan itself produces very little cotton. Korea, however, which is now an integral part of Japan, and known as Chosen, has developed into an important cotton-growing area. In Japan itself the area under cotton decreased from 241,274 acres in 1887 to 6,862 acres in 1911, in which year only 4,029 bales were produced. This local cotton is similar in its character to Chinese, but is rather harsher, coarser and shorter stapled. The bulk of the local cotton is now either hand-woven or used for wadding. Since Korea passed under Japanese control in 1905, a Cotton Cultivating Association has been formed to encourage the cultivation of American Upland cotton in that country, and in 1906 the Japanese Government granted a subsidy. In 1911, after Korea had been officially annexed to Japan, a further Company was promoted which had a capital of £500,000.

The native cotton, which is still almost the only variety grown in the northern province of the country, is similar to the native Chinese and about equal to the lower grades of Indian cotton, but it is now evident that at any rate in the southern part American cotton will grow admirably. As 520 lb. of seed cotton in place of 370 lb. of the native cotton is obtained per acre, it is obviously a more remunerative crop, but it has also a higher ginning output, namely 34 per cent. as against 24 per cent., and its price is at least 25 per cent. higher.

Model farms have been set up in various districts centreing round Mokpo which is at the southern extremity of the Peninsula, and free seed distribution has been carried out on a generous scale. There is a ginning factory at Mokpo which handles the bulk of the crop, and the cultivators are organized into local guilds which work on a co-operative basis, provide good seed, finance the cotton cultivator, and arrange the sale of the crop. To encourage an increase in the area under cultivation a subsidy is given to meet the cost of freight from districts where only a small quantity is grown.

By 1913 there were 35,000 acres of Upland cotton with a yield of 12,000 bales, and over 100,000 acres of native cotton. The bulk of the cotton area is along the western half of Korea. The tendency during the War has been steadily to replace the native cotton by Upland cotton, leaving only about 50,000 acres under native cotton in the north. The total output by now should be about 100,000 bales, all of which goes to Japan. It will thus be seen that neither China, Japan or Indo-China are likely to supply any considerable quota of raw cotton to the European markets.

(F) FOREIGN OCEANIA, ETC.

In the non-British areas of the Pacific Isles a little has been done to develop cotton growing.

PHILIPPINES

Total exports in 1913 . . . . 6,049 bales

According to the U.S.A. statistics the cotton crop on these Islands in 1902 was 6,098 bales, which was mostly grown as a catch crop. Considerable quantities used to be raised for local consumption, but the importation of cheap cotton cloths and yarn from China and Japan reduced the production to insignificance. There does not, however, seem any really good reason why the Philippines should not produce a considerable quantity of medium grade cotton.

DUTCH EAST INDIES

In the Dutch East Indies (Sumatra, Java, Borneo, Celebes and New Guinea) there is a considerable amount of cotton grown, chiefly in Palembang (Sumatra) and Demak (Java), but the great difficulty is climatic, which is too humid. For these reasons numerous efforts to introduce superior exotic types have failed, as they are unable to stand the constant moisture as well as the native types do. In Demak the cotton is grown as a rotation crop after rice, and when the latter crop is late the sowing of the cotton is so long delayed that the crop is not ripe when the rainy season sets in. The native cotton is a short staple, approximating to that of India, and attempts to improve the native cotton by hybridization have not been a success. The Dutch National Cotton Association has been doing a considerable amount to encourage the extension of cotton growing, particularly by giving the growers advances, and sending out ginning plant and baling presses.

Exports from the Dutch East Indies in 1913 amounted to 30,000 bales.

TIMOR

In Timor, which is partly Dutch and partly Portuguese, there is a certain amount of American cotton grown by a Company with its headquarters at Hong Kong. Egyptian varieties which were tried proved a failure, and no reliable information is at present available.

NEW CALEDONIA

This island belongs to France, and possesses a tree cotton, and this and Caravonica are the kinds mostly planted. The French Colonial Cotton Association has done good work in this area, and there are two ginneries at Noumea to which large quantities of seed cotton are brought from the New Hebrides which lie to the north. Since 1908 cotton growing has steadily progressed, and the crop in 1913 was 1,135 bales of 500 lb., with a promise of a further development. The plant grows well, even in the poorest soil, and in good soil sometimes gives an average of 1,200 to 1,500 lb. to the acre. The quality is reported as excellent.

The outbreak of the disease affecting coffee, the rival crop, led to the conversion of large areas formerly under coffee to cotton plantations. Labour conditions appear to be fairly easy, and these islands are on the whole the most likely source of a real increase in the cotton areas of the Pacific.

In the French Society Islands, which include Tahiti, cotton was at one time an important crop, and in 1866 the Tahiti crop alone was valued at £100,000, but it steadily declined until in 1903 it entirely ceased. Since then attempts have been made to revive the industry, and both Sea Island and Egyptian varieties have been tried with some success, but lack of labour and the superior attraction of more profitable crops have prevented any real progress. The total output in 1913 was only 70 bales.

HAWAII

It is claimed that if the pink boll worm could be eradicated, this group would produce a considerable quantity of cotton. Caravonica, a tree cotton, has given good results, a yield of 400 lb. per acre having been obtained experimentally ; in 1912–13 some 300 acres produced a crop of 250 bales of 500 lb., the staple being equal to the best rough Peruvian.

Altogether, the total export of cotton from the whole Pacific in 1913 was about 37,604 bales of 500 lb., of which the British possessions contributed only about 100 bales.

CHAPTER V

PROCESSES USED IN THE COTTON INDUSTRY

IN this chapter it is obvious that nothing more than the merest outline of the main processes or branches of the cotton industry can be attempted. In Lancashire each of these is centred in one district. Thus, the raw cotton is mainly dealt with at Liverpool, though Manchester has endeavoured to establish itself as a market ever since the opening of the Ship Canal. Manchester handles fabrics and yarns, but of these only the yarns and "grey" cloth are dealt in on the Exchange, while the trade in other finished fabrics is done outside.

Spinning is divided between Bolton, spinning only fine yarns, chiefly Egyptian and Sea Island, and Oldham, which is almost entirely devoted to coarser "counts" and American yarn. Weaving and finishing likewise have their own centres, so the localization is fairly marked.

The classification of the fabrics is an exceedingly difficult matter owing to the great diversity produced and the highly specialized character of the whole cotton industry, which, indeed, is one of the reasons why the United Kingdom has established herself without a rival in the cotton trade of the world. The experience gained through a clear century is so great that countries now entering into competition still find it impossible to compete with Lancashire in most of the finer grades. Similarly, the detailed knowledge required for the efficient distribution of the products of Lancashire has rendered her selling organization the envy of the world, and any person who attempts to speak about cotton renders himself liable to criticism from men who are specialists down to the smallest detail. The following conditions and definitions must therefore only be regarded as of a general nature and in no sense exhaustive.

The three main branches of the work are :—

1. Spinning.
2. Weaving.
3. Finishing.

When, however, the yarn is intended to be used as sewing cotton or hosiery or lace yarns for the Nottingham trade, the processes are merely spinning and finishing. (1) The spinning process includes many stages, which may be roughly classified into—

(*a*) Cleaning or removing foreign matter such as leaves and other "trash" in the fibre.
(*b*) Straightening the fibres so as to lay them parallel.
(*c*) Drawing out the cotton to the necessary fineness of the thread.
(*d*) Spinning proper, which is the twisting of the fibres together so as to make a continuous thread.

It will be remembered that it is only possible to make a continuous thread out of a large number of separate fibres of about an inch in length because the fibres have a natural twist in themselves, so that by laying a number of them parallel to each other, overlapping lengthwise and then twisting the whole, the convolutions of each fibre are interlocked with those of its neighbour ; therefore the strength of cotton yarn depends on—

(*a*) The strength of the individual fibres.
(*b*) The amount of overlapping of each individual fibre with its neighbours.
(*c*) The tightness of the twisting which interlocks the individual fibres.

The fineness of yarn, however, depends on the fineness of the individual fibre and the number of fibres. Naturally the fewer fibres used in any given length of yarn the less will be the extent of overlapping of each fibre with its neighbours unless each fibre is correspondingly longer. Therefore fine yarns require the use of long, fine, strong fibres. Uniformity of staple is, however, the principal quality required for the production of satisfactory yarns, for if there are a number of short fibres at any point in the thread these would fail to interlock sufficiently with their neighbours and so leave a weak spot which might easily break under the tension of the weaving process. Every effort is made, therefore, to get rid of short fibres by "carding" or combing them out, while at the same time inequalities in the yarn due to the unequal character and strength of individual fibres must be reduced by repeated mixing or "doubling" which runs through the whole process of spinning from beginning to end. These facts thoroughly understood, the general procedure may be given as follows:—

Cleaning

Cotton on arrival at the mill is a solid mass pressed into a bale which must be broken up in the "bale breaker" which pulls the cotton apart. The whole is then passed to the "blower" which removes the heavier foreign substances from the cotton which may not have fallen out in the "bale breaker."

"Scutching" is really a further cleaning process, and the cotton leaves this machine in a "lap," which is a wide web or sheet of cotton about 1 inch thick, with just enough consistency for it to be wound loosely round a roller. In this lap the fibres are still lying in all directions, and the object of the next process is to separate them more completely.

Carding

The carding machine does this and lays the fibres parallel to each other, at the same time removing all short fibres, and from the carding machine the cotton comes out as a thin film of about the same width as the "lap," but is at once condensed by passing through a ring into a "sliver," which is a round, soft and untwisted rope of cotton of about 1 inch in thickness.

Combing

The carding process is repeated when very fine yarns are required in what is called "combing," when any short staple still left is removed. The "slivers," after leaving the carding or combing machine, pass through three further processes, namely "drawing," "slubbing," and "roving." The object of these processes is to mix the different "slivers" so as to make them uniform in thickness and the fibres more perfectly parallel. Meanwhile, the "sliver" is being steadily drawn out until it becomes necessary to twist it slightly in order to keep it together.

Spinning

The final process of spinning is by drawing out the "sliver" to the required length or fineness of the yarn, and it is also twisted or "spun" to give it the necessary strength of cohesion. There are two different types of machine in use, the "mule" and the "ring" frame spindle.

Mule Spinning.—The mule spindle is so called because it is a cross between Hargreave's spinning jenny and Arkwright's roller-frame. When this type of machine is used the processes of drawing, twisting and winding are done separately. The "rovings," that is to say, the "slivers" as they come from the roving machine, are first passed through a series of small rollers set in pairs, each pair being driven at a higher speed than those preceding it, and thus the thread is drawn to the one set of rollers faster than it can leave the previous set, and, as a result, is drawn out still further. As it leaves the last set of rollers it is carried to a small "cop" or bobbin which revolves on a spindle. These spindles are set on a movable carriage which is drawn backwards, thus giving the yarn its final drawing to the necessary length. The carriage then stops and the spindle spins round rapidly and so twists the portion of thread in the intervening space. This done, the carriage runs back to the frame, winding up the spun yarn on the bobbin as it goes. This process is really the same as that of the original hand-spinning which preceded the spinning wheel, and which hand-spinning is still found in use in the East. The cotton, or, if it be wool, wool, is drawn out by the fingers of the right hand and the weight of the spindle from the bundle held in the left hand. The spindle is thus spun by the right hand, then rests to allow the spun yarn to wind on the spindle.

This is the old primitive method from which the mule spinning machine has evolved.

Ring Spinning.—In the ring-frame these three processes of drawing, spinning and winding are done simultaneously, thus saving time and greatly increasing the output per hour. The mule is still used, however, in Lancashire for fine yarn, for the ring spinning machine, though faster and therefore cheaper, does not give such good results. The average output of yarn from a ring spindle is about twice that of a mule spindle.

If the yarn is to be used for sewing cotton the next processes vary somewhat from those employed if it be used as yarn for further manufacturing purposes. In any case, certain of the following processes are employed.

Doubling

Doubling consists of combining two threads into one, and this is done under water ; thus 2/120's means that two threads of 120 counts have been twisted together to make the equivalent of a 60 thread. This process results in a much stronger yarn than would result from a single yarn of the same final weight. "Twisting" is similar to doubling except that the two threads are more tightly twisted together so as to give extra strength.

"Gassing"

is the passing of the thread rapidly through a flame so as to singe off the loose nap from the yarn. The yarn is now finally wound into a number of different forms according to the way in which it is to be used: for example, on warper's bobbins for "warping" or into hanks or bundles.

Yarn Finishing

If the yarn is not to be used in the "grey," that is to say, in its natural state and colour, it is "finished" by bleaching, dyeing, mercerizing, etc. The most important of these finishing processes is—

Mercerizing

The hank of yarn is fastened on a simple frame and dipped into a warm solution of caustic soda. As the yarn cannot shrink, this really results in a further stretching, and the result is to give the yarn a brilliance of lustre almost like silk.

Piece Goods

The number and variety of piece goods is almost countless. They may be either "plain woven" or "fancy woven." In the case of the first, the warp or vertical and weft or transverse threads of the cloth are both homogeneous but not necessarily the same. For example, Egyptian warp or American weft may be used, but in fancy weaving either warp or weft may vary infinitely. Thus cotton, wool and silk may be used in alternate shades or stripes; the quality of the yarn may vary or the count of the yarn or even its finish, and, finally, the colour, some threads being white, others dyed and so forth. In the finishing of piece goods infinite variety is also possible. Plain woven grey cloth may be bleached, dyed, mercerized, printed, etc., and some of these processes result in making a piece of fine Egyptian cloth look like silk or even satin.

In conclusion it may be pointed out that the total make of single yarn in 1907 was 1,800 million lb., worth at that time an average of 1*s.* per lb. or the total of £90 million. At that date the average cost of the raw material per lb. of yarn was only 7*d.* or 60 per cent. of the average value of the yarn. It is interesting to note that at that date only about 10 per cent. of the total product of cotton yarn was bleached or dyed, showing that the bulk of the yarn was woven in its natural state into grey cloth.

Miscellaneous Uses

Miscellaneous cotton manufactures include a vast variety of articles such as belting, tape, waste (which is used for packing), gun cotton, etc., and besides this for the vastly important lace and hosiery industries. In 1907 the lace and hosiery trade produced about £19,789,000, of which lace represented about half. There has been no figures of production since that year, but probably the total value of the cotton industry has fully doubled.

CHAPTER VI

PRICES OF COTTON

COTTON has always been a crop which fluctuates very considerably in price. A few prices in the years preceding the War will bear out this fact.

In January, 1836, Middling, Orleans stood at	9½*d.*
,, ,, 1846 ,, ,, ,,	4¼*d.*
,, ,, 1856 ,, ,, ,,	5⅝*d.*

During the period of the American Civil War the prices were as follows :—

1862	12¾*d.*
1863	22½*d.*
1864	27½*d.*
1865	24¼*d.*
1866	19½*d.*

After this period prices began to fall once more.

In 1876 it was	6 15/16*d.*
,, 1886 ,,	5⅛*d.*
,, 1896 ,,	4½*d.*
,, 1906 ,,	6⅛*d.*
,, 1909 ,,	5⅛*d.*
,, 1912 ,,	5¼*d.*

Just previous to the outbreak of the War prices were fairly moderate, and as they will prove of historic interest we will give them under three headings as follows :—

Date.	Middling Uplands.	Middling Uplands New York.	Egyptian.	
			Good, Fair.	Sakellarides F.G.F.
	lb.	lb.	lb.	lb.
	d.	cents.	*d.*	*d.*
Dec. 31, 1913	7·14	12·60	9·65	—
1914	4·58	7·80	6·05	—
1915	7·75	12·40	9·80	—
1916	10·64	17·40	19·65	—
1917	22·49	31·75	31·15	—
1918	20·99	32·70	27·05	—
1919, Jan. 31	19·76	25·60	27·05	—
Feb. 28	18·76	26·65	26·84	—
Mar. 31	19·45	27·40	26·84	—
Apr. 30	19·25	28·50	26·34	—
May 31	18·55	31·55	26·34	—
June 30	20·32	34·95	26·84	—
July 31	21·44	35·25	26·84	—
Aug. 31	19·74	31·25	29·27	—
Sept. 30	19·55	31·80	29·75	—
Oct. 31	24·90	38·35	34·30	—
Nov. 30	26·21	39·85	37·00	—
Dec. 31	28·71	39·25	47·50	54·00
1920, Jan. 31	29·63	37·05	69·00	77·00
Feb. 14	30·79	37·75	82·00	91·00
Sakel was rising rapidly. On February 16 the figures were			84·00	97·50

From the figures for 1919 it will be seen that on the whole cotton has kept up to its high average during the War, and it cannot be said that there is any great likelihood of any considerable reduction in the cost of the raw material of this important industry. This, of course, is due to the world shortage and the tremendous demand for cotton goods in all parts of the world, which has been aggravated by the decrease in manufacture during the War. The price is quite likely to go even higher. The lowest price touched in recent years for American Middling cotton was during 1894 when it touched 3*d.* per lb. in Liverpool, the average price for the last twenty years for Americans fluctuating between 5½*d.* and 7*d.*

Another significant feature is that owing to the fall in value of the £ in New York, despite the fact that there was a slight fall in the value of the cotton in cents. in December in New York, the price in pence in Liverpool rose. Owing to the increasing importance of Egyptian Sakel that quality has been included from December to February.

Indian Cotton

The prices of Indian cottons are practically always below those of American Middlings, as the cotton is of much lower quality. In 1889–90 the percentage to American was 81 and, despite various fluctuations, up to as high as 96 in 1897–8. At the outbreak of War it still stood about 81.

The price in 1913–14 of Indian No. 1 Oomras was as follows :—

Highest	6·56*d.*
Lowest	4·70*d.*
Average	5·87*d.*

and the average for the last 5 years, 6·27*d.* or 87 per cent. of American Middlings.

Egyptian Prices

Egyptian prices have always been higher than American Middlings. In 1889–90 the percentage rate was 119, and in the last five years before the War 147. In 1913–14 the figures were as follows :—

EGYPTIAN FULLY GOOD, FAIR, BROWN.

Highest	10·45*d.*
Lowest	8·15*d.*
Average	9·44*d.*
Percentage to American	130

CHAPTER VII

THE WORLD'S SHORTAGE OF COTTON

ACCORDING to the *Commercial and Financial Chronicle*, the world's commercial crop of cotton in recent years has been as follows :—

Countries.	1914–15. Bales.	1915–16. Bales.	1916–17. Bales.	1917–18. Bales.
United States . . .	14,766,467	12,633,960	12,670,099	11,547,650
East Indies . . .	3,337,000	3,625,034	4,100,000	3,950,000
Egypt	1,235,487	892,172	950,000	1,167,000
Brazil, etc. . . .	240,000	220,000	270,000	500,000
Total	19,578,954	17,371,166	17,990,099	17,164,650

and the corresponding consumption was as follows :—

Countries.	1914–15. Bales.	1915–16. Bales.	1916–17. Bales.	1917–18. Bales.
Great Britain . . .	3,900,000	4,000,000	3,000,000	2,900,000
European Continent .	5,000,000	5,000,000	4,000,000	3,000,000
United States . . .	5,805,695	7,109,719	7,430,688	7,173,946
East Indies . . .	1,648,468	1,723,011	1,764,000	1,775,000
Japan	1,538,210	1,747,382	1,774,960	1,850,000
Canada	185,287	208,040	190,915	249,468
Mexico	44,009	19,600	5,000	10,092
Other Countries . .	625,000	536,000	1,000,000	585,000
Total World . .	18,746,669	20,343,752	19,165,563	17,543,506

During the War the consumption of linters has vastly increased ; thus, whereas in 1913–14 the United States consumed barely 300,000 bales, during 1916–17 the total rose to 869,702 bales, and in 1917–18 to 1,116,385 bales. Naturally, the export declined at the same time, dropping from 436,161 bales in 1916–17 to 187,705 in 1917–18. This large consumption of linters was chiefly due to the demand for explosives, for most of which linters form the foundation as gun-cotton. Despite heavy demands and the restriction which the shortage of supply due to the War placed on the production of cotton goods in the United Kingdom, the total export value of cotton goods has remained high, and indeed increased. In 1916 the total value of the cotton exports was £92,486,903 ; in 1917 it was £118,709,326, and in 1918 £147,651,148. But this rise in value was accompanied by very considerable shrinkage in the quantity exported, so that while the producer has not suffered very heavily, the consumer abroad has had to pay much higher for much less, and this tendency has certainly continued since the War ended. This fact is significant, and, unfortunately, it would appear as if the tendency is likely to continue for supplies to decrease, and consequently prices rise.

As will be seen from the figures of production and consumption, the supply of cotton is not keeping pace with the demand. The American cotton crop for 1918–19 is roughly estimated at 11,700,000 bales, exclusive of linters, which is only 398,000 bales more than the short crop of 1917–18. This is despite the fact that the area under crop is about 41,107,000 acres, representing the largest acreage in the United States ever devoted to the production of cotton ; but the production per acre is said to have fallen to about 155 lb., whereas in pre-war days an average of 200 lb. was usually obtained.

The Egyptian crop for 1918–19 is also slightly down, and in India the acreage for 1918 fell from 21,195,000 acres in 1917–18 to 15,874,000 in 1918–19. It therefore follows that the world's total output for last year is smaller than in the previous year, and stocks, which are already low, will have to be still further drawn upon. The cotton year of 1914–15 ended with a surplus of 8,351,500 bales. In the two following years the stocks were reduced to almost half, and for 1917–18 a further reduction of some two million bales was only prevented by drastic restriction of the consumption, the deficiency for that year being thus reduced to only 370,856 bales. At the beginning of January, 1919, the stocks in Europe amounted to 639,000 bales against 2,073,000 before the War. Of this small margin, 534,000 bales were in Great Britain, but the stocks at Havre, Barcelona and Genoa were less than half those of the corresponding previous year. On the other hand, during the War the number of spindles in Japan and America has greatly increased. In particular from 1910 to 1916 the number of spindles in Japan rose from 1,896,601 to 3,045,676. Since then they have steadily increased further. Nevertheless, one is apt to over-estimate the effect of this increase on the world's supply of raw material, for Japan only holds about 2 per cent. of the world's total spindles, which in 1918 numbered some 147,081,748. Of this total 57 million were in England, 43 million in other countries of the European Continent, and nearly 34 million in the United States. It is the latter country which is really developing most rapidly, though there are no figures available for 1919, but we do know that a considerable increase in the number of spindles in the States has taken place. As has been several times pointed out, the States are by far the largest producer of commercial cotton in the world, and the more she tends to absorb this cotton in her own mills the less there is left for other countries. Not only is she consuming more, but she is producing less per acre, and the ravages of the boll weevil and other pests are quite likely to discourage many of her planters, and even induce them to give up growing cotton.

In Egypt no very rapid increase is possible, nor indeed in any part of Africa within the British Empire, with the exception of Nigeria, and the total contribution of Nigeria for many years will be comparatively small.

China is also developing her industries rapidly, and any surplus she can spare will be readily taken up by Japan.

Russia in her present state of chaos is quite unable to render any assistance.

In Oceania the production of cotton is trifling and likely to remain so, owing to the more attractive nature of other crops.

A certain amount of increase might come from some of the South American States, but in any case it will be a poor grade cotton and the amount is not likely to be considerable for many years.

There are only three large areas where an increase in the supply of cotton on a considerable scale seems possible. The first and smallest of these is the West Indies. It is important because good-class cotton can, undoubtedly, be produced there, and every effort should be made to induce the West Indies to grow Sea Island and similar grades of cotton of the finest qualities which are so badly needed in Lancashire, and above all in Nottingham; but it must be admitted that labour difficulties, except in one or two favoured spots, render this somewhat unlikely. India and the former Turkish Empire are the two chief areas which appear possible. With regard to India, the trouble in the past has been primitive methods of cultivation and a bad system of preparation. Indian cotton also is for the most part short staple and only suitable for low grade cotton goods. The bulk of the surplus supply not required in the Indian mills is being promptly taken up by Japan, and unless a higher grade of cotton is produced in the northern provinces it is unlikely that much of this cotton will be suitable for Lancashire and the fine cotton-spinning areas. Scientific and energetic efforts concentrated on this area may yet, however, succeed in producing a considerable addition to the American Upland type, which can be grown in favourable areas in India, and the attention of cotton users and of financiers is directed to this possibility. There should be no shortage of labour supply at a reasonable rate, which is a most important point. Prompt action is required to encourage the production of high-class varieties if the threatened cotton famine is to be averted.

Turning to the last area we find a vast number of districts scattered in different parts of the Turkish Empire which are quite suitable for cotton growing, but perhaps the most attractive are Mesopotamia, Syria and Palestine.

With regard to Mesopotamia, adequate irrigation schemes will bring under cultivation large tracts eminently suitable for cotton growing, probably producing varieties similar to middling Egyptian, which should be a most valuable addition to the cotton supply of the world. Now that this area has passed under British control and law and order established, there seems a real prospect of something effective being done, and it is sincerely to be hoped that the opportunity now created will be taken advantage of at once.

Palestine is also likely to be under British protection for many years, and if adequate encouragement is given to the local cultivators, there seems no reason why good-class Egyptian, or possibly Upland American, cotton might not be grown in suitable areas.

With regard to Syria, there are undoubted possibilities, and we may hope that the French, who are establishing a Protectorate there, will in their own interests do everything to encourage the production of cotton. This supply will probably go to the French mills, thus reducing their demands on the already decreasing American supply. The proximity of these last two areas to the European ports would render it possible to land the cotton at the manufacturing centres at a comparatively low transit rate, and for this reason it should not be neglected even if Mesopotamia appears to present better prospects of a large output.

Briefly, these last areas are the only ones of which it can be truthfully said there is much prospect of a considerable addition being made to the cotton supply of the world. On the other hand, there is an absolute certainty that the consumption of cotton goods will increase. Cotton is more and more replacing all other textiles among civilized races. There is also the possibility of a shortage in wool, and the tendency has been to replace the more expensive material by cheaper cotton, even in countries where the warmth of wool is a great asset. In addition, the spread of civilization all over the world among the backward races is creating a tremendous demand for cheap cotton goods. The consumption of cotton in Asia is enormous. All over the dark Continent of Africa native garments are giving way to cheap cotton piece goods. The same thing is taking place in the Islands of the Pacific, on the slopes of the Andes, and in the jungles of Central America. It seems highly probable that before many years have passed practically the whole world will be clad, for the most part, in cotton. Under these circumstances, unless an enormous increase in supply takes place, there is bound to be a serious cotton shortage, resulting in a still higher rise in the price of the finished article, which in its turn must inevitably breed discontent and social disorder.

Clothing and food are two of the few necessities which are absolutely essential, and without which men become discontented and life seems to them unendurable. To the Englishman in London, the price of a cotton shirt may seem exorbitant, but he can, as a rule, pay for it. In large parts of India the price of cotton goods charged during the War was so far beyond the means of the people, that they were reduced almost to a state of rags. Discontent at the high price of cotton goods was not the least of the causes of the recent troubles in India, as the writer himself has been informed by several highly educated natives of India who are by no means hostile to English political dominion there. When we turn to consider the fact that there is a possibility of a shortage in wool, the seriousness of the whole situation becomes manifest.

Statistics of Cotton Consumption in 1914

It is estimated that at the outbreak of the War there were 145,000,000 cotton-spinning spindles in the world which, when in full use, consumed about 24,000,000 bales of cotton annually. Of these spindles—

Great Britain had	40 per cent.
All other European Countries	30 ,, ,,
The U.S.A.	21 ,, ,,
India and Japan between them . . .	6 ,, ,,
All other Countries (together) . . .	3 ,, ,,

The annual consumption before the War was—

The U.S.A.	25 per cent.
Great Britain	20 ,, ,,
All other European Countries	34 ,, ,,
India and Japan together	16 ,, ,,
All other Countries	5 ,, ,,

The reason why the British consumption was so small and that of India and Japan so large in proportion to the number of spindles owned is that Great Britain produces yarns of comparatively fine counts, which means that her consumption per spindle is small, whereas India and Japan produce coarse counts entailing a large consumption of cotton per spindle.

The proportion in which raw cotton was produced in 1914 is as follows :—

The U.S.A.	64 per cent.
India	18 ,, ,,
Egypt	6 ,, ,,
Russia	4 ,, ,,
China	2 ,, ,,
Brazil	2 ,, ,,
All other Countries	4 ,, ,,

The total world's production had sunk in 1915–16 to about 20,823,000 bales, but the consumption was 24,500,000. In 1916–17 the crop was 21,514,000 and the consumption 23,135,000.

In 1914–15 the surplus carried over was about 8,351,500 bales. By 1916–17 this was reduced to about 4,000,000 bales. By restricting consumption the further decrease, which would have been another 2 million, was reduced 378,856 bales, leaving 1918–19 with a balance of stock of about 1,600,000 bales. Since then consumption has vastly increased and not production. On January 1, 1919, the balance in Europe was only 639,000 bales as compared with 2,073,000 before the War. Of this 639,000 bales some 534,000 bales were in Great Britain.

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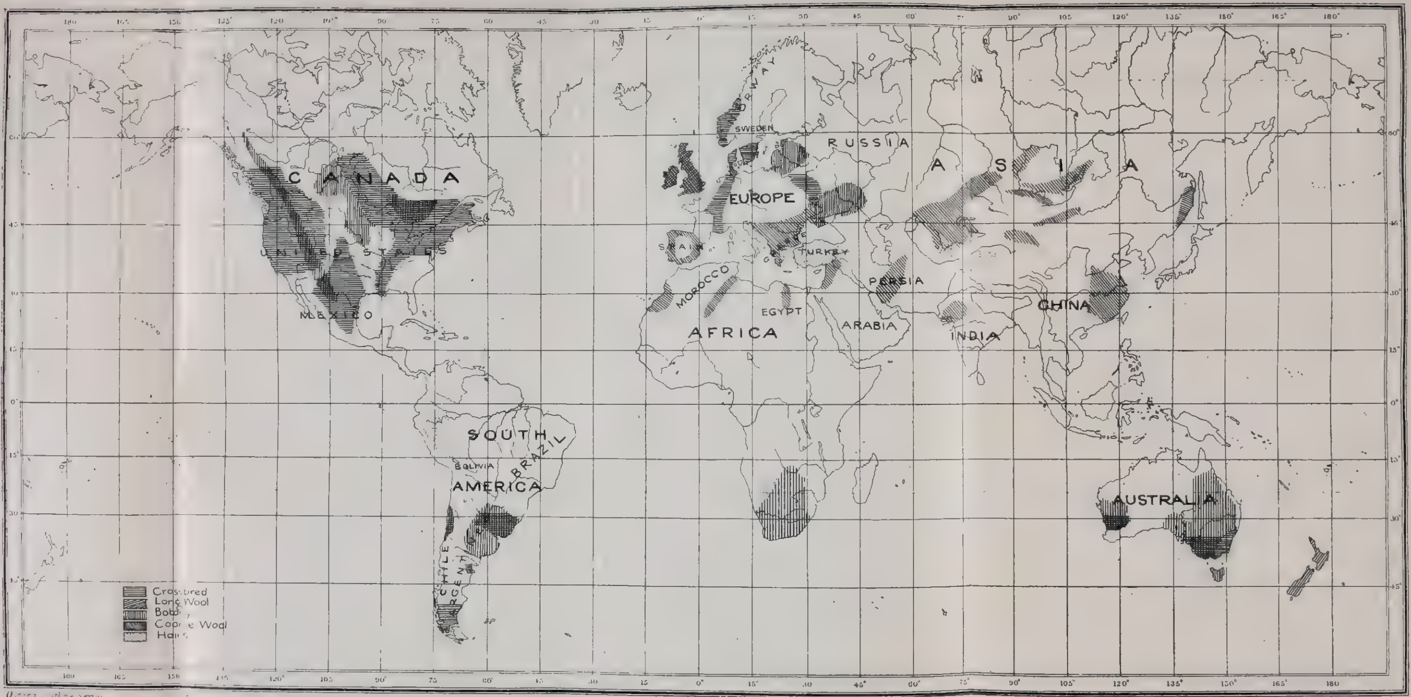
PART II

WOOL

THE WOOL-PRODUCING AREAS OF THE WORLD



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CHAPTER I

CLASSIFICATION OF WOOL

Sheep

THE variety of breeds of sheep existing at the present time is almost innumerable. They range from the little mountain sheep of Wales and Cumberland to the heavy Southdown, from the Merino sheep with its fine wool to the coarse-wooled sheep of India and Siberia, whose wool is almost as coarse as hair and usable mainly for carpets. The types differ in every climate and latitude. The British Isles epitomizes the sheep population of the world, and there are few varieties of sheep, except the Merino, which have not had their origin in Great Britain. Roughly speaking, we may divide them into three main groups so far as their wool is concerned : the Merino and those approximating to it, whose wool is fine and soft ; the innumerable half-breeds and cross-breeds, where the wool is of good quality but somewhat grosser than Merino wool ; and those sheep whose wool and hair is mainly used for carpet making, as, for example, most Oriental sheep.

Chemical Composition

Wool is a combination of carbon, nitrogen, hydrogen, oxygen and sulphur in proportions which vary according to the sample and how much it has been purified. Usually there is 50 per cent. of carbon to the total weight, nitrogen 17 per cent., oxygen 20 per cent., hydrogen 7 per cent., sulphur from 2–5 per cent. The chemical formula assigned to wool by Dr. E. J. Mills, F.R.S., is the same as that for Keratin, namely, $C_{42}H_{157}N_5SO_{15}$.

The raw material contains earthy matter which is removed on scouring ; animal perspiration, usually called suint ; fatty matter; pure wool and moisture. The suint consists mainly of soluble salts and potassium, and the fats of a solid fat or suet called stearerin and an oil fat called elairerin. Lanolin, which is so valuable in medical preparations, is a form of cholesterin obtained from the wool oil.

Classification of Wools

British wools are classified as Lustres, Demi-lustres, Downs, Half-breeds and Mountain, and these kinds are divisible into two chief sorts, long and short. Under the long wools come the Lustres and Demi-lustres, which are divided as follows in the *Wool Year Book*—

LUSTRE WOOLS

				Price
LINCOLN (which is the longest and strongest type)	12″ staple	10–12 lb.	36's qlty.	19*d.* (1918–19)
LEICESTER (the choicest long wool in England)	10″ ,,	9–10 lb.	40's ,,	19*d.*
NOTTS (similar to Leicester)				19*d.*

Most of these wools are used for dress fabrics, braids and linings.

DEMI-LUSTRE WOOLS

				Price
BORDER LEICESTER (a cross between a Leicester and a Cheviot obtained from South Scotland). . . .				
COTSWOLD (GLOUCESTER) (not as lustrous as Leicester) . . .	8″ staple	8 lb.	44's qlty.	14*d.*
ROMNEY MARSH (KENT) (smaller sheep and softer wool) . . .	7″ ,,	7 lb.	44–46's ,,	22*d.*
ROSCOMMON (from the Irish Lowlands) .	8″ ,,	8 lb.	44's ,,	22–23*d.*
WENSLEYDALE (N. YORKS AND DURHAM) (a hard wool)	9″ ,,	9 lb.	36–40's ,,	19*d.*
DEVON (a long wool) .	9″ ,,	9–10 lb.	36–40's ,,	16*d.* (greasy)

These are largely used for dress fabrics, serges, flag bunting, etc.

The typical short and medium wools are Down wools :—

				Price
Southdown (Sussex) (which is the shortest and smallest fibred wool in England) .	3″ staple	4½ lb.	56–58's qlty.	23½*d.*
Shropshire Down (a larger and hardier breed)	4½″ ,,	6 lb.	46–50's ,,	23*d.*
Suffolk Down (resembles Sussex Down but not so fine) . .				
Oxford Down (was originally a cross between Cotswold and Norfolk, but the wool is rather inferior) .				
Hampshire Down (is the largest type of Down sheep) . .	4½″ ,,	6 lb.	50's ,,	22½*d.*
Wiltshire Down (similar to Hampshire)				
Dorset Down (fine, close wool) . . .	4″ ,,	4–5 lb.	50's ,,	23*d.*

Most of these Downs are used for hosiery and cheviot cloths, as down wool is of poor felting quality.

Special Wools

				Price
Cheviot (South Scotland and Highlands) (fine, dense, soft wool. Sutherland Cheviot is the cleanest and best)	4″ staple	4½ lb.	46–50's qlty.	21*d.*

Used for Cheviot tweeds entirely.

Herdwick (Cumberland, Westmoreland) (tender and kempy; similar to Cheviot in length, weight and use)				12½*d.*
Blackfaced (Scottish Highlands) (uneven and kempy) . . .	6–8″ staple	5 lb.	28–32's qlty.	12½*d.*–13*d.* (greasy)

Use—Carpets and homespun tweeds.

				Price
Welsh (Mountain and Radnor) (similar in quality and uses to the poorer types of Down wool) . . .	5″ staple	3½ lb.	36's qlty.	15*d.*
Shetland (very light, mixed wool and hair, plucked by hand, not shorn)				

Used for hosiery and knitted goods.

Half-bred Wools

				Price
North (is a cross between Border Leicester and Cheviot. It is by far the most important and valuable and is usually classed as Demi-lustre wool)	6″ staple	7 lb.	46's qlty.	22½*d.*
Scotch Cross between Leicester and Blackfaced, or Cheviot and Blackfaced. Inferior in quality . . .				About 17½*d.*

Other well-known crosses are :—Down-Cheviot, Leicester-Down, Down-North, Leicester-North. These are, however, never used for breeding. Lambs or hogs are fed and slaughtered as they reach condition for butcher. Hence these wools are chiefly from skins.

Prices are for hog wool. Wether wool is from ¼*d.* to ½*d.* lower in price per lb.

Skin Wools

These are obtained from the fell-mongering industry and consist of wools removed from the skins of sheep which have been slaughtered. When proper methods are adopted wools of excellent quality may be obtained, but often, owing to unsatisfactory treatment during the separation and to lack of sorting and picking, etc., they are found to be useful only for medium and low-class goods. In such cases the defects noticeable are :—

They lack spinning properties, are dead and harsh and do not mill or dye as well as fleece wools do. They fall into three main divisions :—

(1) "Skin" Wools, sun-dried and removed from the skin by a process of sweating;

(2) "Skin" Wools, separated by a chemical agency, the most usual being by sodium sulphide;

(3) "Slipe" Wools. These are removed from the skin by the application of lime.

The skins are obtained from all sorts of breeds, chiefly from Merino and good cross-bred or English types.

The best kinds of "skin" wool are obtained perhaps from Mazamet in France, where the business is usually well carried out; but abroad the methods adopted are often careless and unsatisfactory and naturally result in comparatively low prices being obtained.

The average Colonial skin yields 4 lb. of wool and about 1½ lb. of leather. When the skins are sweated they are first hung up moist in a closed chamber until putrefaction sets in. This loosens the fibre and pulling becomes easy. One of the defects from which these types of wool suffer is, a considerable amount of the essential grease in the fibre itself is washed out in the process. This is partly due to the fact that ammonia is produced owing to the putrefaction, and this, coupled with the free use of water in the burring machine, washes out the essential grease, together with matter which is deleterious. Sweated wools thus lose much of their elasticity and do not felt well. Whereas the first type of sun-dried and sweated wools are usually obtained from England and the Continent, the chemically separated types come mainly from the Colonial fell-mongering stations. This system, namely by means of sodium sulphide, is perhaps the best. This chemical destroys the epidermis of the skin while improving the quality of the pelt, but a 10 per cent. solution will dissolve wool completely in fifteen minutes. Care has therefore to be used in applying it to any skin from which it is desired to obtain wool. The usual method is as follows :—After washing, the skins are painted on the flesh side with a thick coating of sodium sulphide and are then allowed to lie all night, with the result that the roots of the wool become loosened as the hair bulbs have been destroyed. The wool is then pulled by hand.

"Sliping" is mostly found in use in England, but it is a thoroughly bad method, as the lime penetrates the fibre and the wool is left harsh, grey and dull. At the same time the operation of washing is rendered more expensive and difficult. Any wool which has lime mixed in with it requires fifteen times the same quantity of soap to cleanse it. Other methods for cleansing the wool from the lime have been tried, but none are satisfactory and the process is going out of use. "Skin" wools are generally employed as blending material with fleece wools for medium-class worsted and wools as they supply bulk, while the better and more expensive material gives the distinctive characteristics.

"Slipe" wool is used for certain serges and hosieries of the medium and low qualities, and is also utilized in the manufacture of carpets, wool suitings, blankets, flannels, etc.

Hairs

In addition to wool, certain hairs are employed, sometimes in conjunction and sometimes alone. The principal types are mohair, alpaca, cashmere, camel's hair and cow's hair. Mohair comes mainly from two areas and is obtained from the Angora goat. From Turkey a good, lustrous quality is obtainable, the average price in 1913 being 15*d.* to 17½*d.* per lb. From the Cape comes a slightly inferior quality averaging 13*d.* to 14*d.*, though Cape kids average about 28*d.* per lb. The U.S.A. types vary in value from 11*d.* to 15*d.*, while the Australian average 12*d.* Most of these mohairs are used in the production of dress fabrics, linings and plushes.

Alpaca is obtained from the Peruvian goat. The average price in Liverpool is about 9½*d.* to 10*d.*, but the Arequirpa fleece averages 19*d.* to 19½*d.* It is used almost entirely for dress fabrics and linings.

Cashmere is obtained from the Tibetian goat and comes from Thibet, China and North India. Best quality machined skins fetch 22*d.* to 26*d.*, and the material is employed in the making of shawls and hosiery. It is in considerable demand in Bradford, Germany and the U.S.A.

Camel's hair came mostly from China and Russia and averaged 18*d.* to 20*d.* per lb., its principal use being to obtain special effects in tweeds and hosiery.

Cow's hair in a scoured state averages 4*d.* and is utilized mainly at Leeds, Batley, Dewsbury, etc., in the making of carpets, rugs and blankets.

The only other hairs worth mentioning are : rabbit's hair, which is largely employed in the hat trade ; vicuna wool, mainly used in the manufacture of shawls ; horse hair, which is used for upholstery ; and kangaroo hair, which is blended with other materials for sacking.

Re-manufactured Materials

Woollen rags are re-used for the making of cheaper cloths, ready-made suits, etc. The various types are as follows :—Mungo, Shoddy, Extract, Flocks, Waste. Noils may also be grouped with these re-manufactured materials, although in many ways they are better.

Mungo and **Shoddy** are very similar. They are obtained from the rags by dusting, sorting, seaming, oiling and grinding. The first two need no explanation. Seaming means the abstracting from the rag of every bit of cotton thread which would otherwise cause a "flecked" piece, that is, a badly spun piece. Oiling is to enable the fibres to glide on one another and thus avoid a rupture. Grinding is the teasing out of the fibre so that as much as possible of the original length of the raw material is retained.

Extract is manufactured in a very similar way to the last two except that the material is obtained from cotton and wool cloths, from which the cotton has been extracted by a chemical process, such as the use of sulphuric acid.

"**Merino**" is sometimes used to note a sub-division of shoddy and indicates that the rag is obtained from good quality soft worsteds.

"**Flocks**" consist largely of short-length refuse, some of which is so short as only to be usable for the manufacture of paper. Their principal use is, however, for stuffing.

Noil is short wool consisting of naturally short and broken long fibres which the wool-comber throws out during the combing of wool. They are, therefore, not strictly re-manufactured material and are often almost as valuable to the wool manufacturer as wool proper. The latest tendencies in wool combing are, however, to straighten the fibres rather than comb out all the short fibre, and as a result the noils grow shorter and shorter as less broken long fibres are left.

"**Wastes**" fall under two heads, soft and hard. Soft waste includes top waste, that is, pieces of top broken off sliver and slubbing and roving waste, whereas hard wastes consist of the residues from the ring frame, the mule and the warping, winding and roving machines. Soft waste from the woollen mill practically never appears on the market, as it is blended with the ordinary batches and is but little inferior to the wools from which it is obtained. The Worsted industry sells its waste to the woollen makers.

To a certain extent wool waste is used for manurial purposes, the most valuable constituent being the nitrogenous compounds present.

VEGETABLE WOOLS, ETC.

Certain vegetable and other non-wool fibres are sometimes used in conjunction with the wool industry. It is only necessary to mention them in passing.

Ramie, which is obtained from China grass, is sometimes utilized in the form of Ramie noils for carding wool materials. It is claimed that Ramie when mixed with wool, particularly for stockings, renders them holeproof, but at the same time the criticism has been made that these are exceedingly hard.

Marine Fibre.—Endeavours have been made to utilize peat fibre, but only with a limited success. Efforts to utilize Marine fibre, for mixing with wool and the making of blankets, carpets, etc., have met with but little success. In 1912, at Mincing Lane, bales fetched 2*d.* to 2½*d.* per lb. The raw material is a seaweed, *Poseidonia Australis*, dredged from Spencer's and St. Vincent's Gulfs, South Australia.

Kapok is weaker and more lustrous than cotton and is obtained from a tree, *Eriodendron anfractuosum*, which grows in the Dutch East Indies, India, Ceylon, tropical Africa, Central America, etc. It is principally used for stuffing, and one of its great advantages is, that it may be sterilized by heat with less risk or damage than most alternative materials used in upholstery. Further, it is exceedingly buoyant and has been found suitable for the manufacture of life-saving clothes and appliances. It is said that 1½ lb. of Kapok will support 23 lb. in water. Owing to its smooth surface, the fibre is usually treated with chemicals to roughen the sides and give cohesion to the yarn. The yarn dyes but does not bleach well, and is silky and soft. Life-saving waistcoats were made of this material during the War for people travelling by sea.

Silk noils and **artificial silk** are also utilized. They are chiefly used for blending with wool yarns to obtain "effects" in certain cloths.

Paper Yarn.—During the War considerable progress appears to have been made with the use of paper yarn, particularly in Germany and Sweden. For the most part it has been used, however, as a substitute for cotton rather than wool. Some of the most effective results exhibited in England by a British firm who took up the matter were obtained from the manufacture of sacks and stair carpets, which appear to resemble cheap jute carpets. That it can be utilized successfully in conjunction with wool at present seems improbable.

Types of Sheep

Although details have been given of the various types of wool produced, it would be as well to briefly divide the main types of sheep.

Of all the sheep in the world, probably the most important from the point of view of its wool is the Merino, the original home of which was in Spain. In its original state it was a hardy, frugal, white-woolled animal, living on bare lands, and had been developed from a certain native sheep which is believed originally to have been perfectly black. It produced, and still produces, the softest of all wools and the finest and whitest, and for many years the Spanish authorities protected it and prevented its exportation. The Spanish Government permitted the sale of the fleeces and the wool, but never the sheep, and as late as the beginning of the nineteenth century they were sending us 6 million lb. out of a total of 8 million lb. which they were exporting annually.

In 1787 George III received a present from the Spanish Government of a small flock of these Merinos, and the present was repeated in 1791. Soon after this date, possibly by means of smuggling, other Merino rams got out of Spain and became the sires of flocks in Saxony, Australia, Holland, England and America. The Saxony flocks, in particular, were carefully developed, so that ultimately they produced the finest wool, principally at Lohman. The Austrians centred their flocks at Histotz; the Dutch sent some of theirs to the Cape; while the Americans centred their flocks at Vermont and the French at Rambouillet. George III kept his at a special farm at Kew, and every country developed their flocks in different manners.

From these originals most of the famous breeds of the world have come. Australia obtained her supply partly from England and partly from the Dutch. It is stated that Captain John MacArthur, stationed at Sydney, is the real founder of the Australian flocks, and to-day Australia sends to England alone 320 million lb. of wool each year, while New Zealand sends about 190 million. Such is the vicissitude of time that Spain, whence the Merino originally came, has long since ceased to send any wool at all. Among the types now produced in England by breeding and cross-breeding, the following are specially worthy of note:—

(1) **The blackfaced North of England and Scotch** varieties which have good mutton qualities, but their wool is not of the best class, although it is of considerable value.

(2) **The Welsh and Cheviot breeds** are a little higher and the Cheviots produce the still better fleece.

(3) **The Leicester** is, however, the most valuable of the native breeds. Formerly it was big and coarse, but about the middle of the eighteenth century the new Leicester type was developed, of superior quality and excellent shape and producing the best of wool. Of late years it has been used considerably for crossing with other breeds, and some fine long-woolled sheep have resulted, the most successful results being from crosses between Lincolns and from Romney Marshes.

(4) **The Lincolns,** indeed, have done more than any other

breed for the improvement of English sheep in recent years. The Lincoln is itself a cross between the improved Leicester and the native sheep of the county, and produces excellent long wool which is lustrous, and the fleece is often of considerable weight.

(5) **The Cotswolds** are famous long-woolled sheep and were noted even in the fourteenth century.

(6) **The Southdown,** which of late years has been greatly improved, produces a very good short wool.

Of the other breeds, the Shropshire produce a good thick wool rather like Southdown. The Devon is a long-woolled variety. Romney Marsh, Suffolk and Wensleydale, as well as several Scotch breeds, are also of considerable value. In Ireland the Roscommon is the principal breed kept. It is a native variety, improved by crossing with the Leicester.

Further reference will be made at a later date to the spread of other varieties, due to the crossing of rams with pure Merino and Rambouillet all over the world, and it is only necessary to mention that the Asiatic sheep is very distinct, as a rule, unless it has been crossed with some of our European or Merino breeds. Its wool is coarser and more like hair, and is mainly used for carpets such as those made in Turkey and Persia.

What Wool Is

It may be as well here to distinguish between wool and hair as far as this is possible. There is considerable conflict of opinion between experts on this subject. Some maintain that wool is only a modified form of hair, and others that wool and hair are absolutely distinct. Professor Barker, the well-known Yorkshire authority, maintains the former view. He points out in his arguments that the fine, soft wool of the Australian merino merges into the cross-breed of New Zealand, which merges into the long English and lustre wools, which in turn merges into alpaca and mohair ; and again, animals such as the camel and Kashmir goat produce fibres which would be hard to classify either as wool or hair. On the other hand, other authorities, such as a writer in *Chambers' Encyclopædia,* state definitely that wool is not a hair at all, that it differs in that it possesses a more fully developed serrated circumference and has an increased degree of flexibility, elasticity and waviness. Youatt, an older authority, thus describes the differences between the two substances :—

"The fibre of wool is crisp or curled, the curls increasing with the fineness and felting property of the wool, and in addition to this its surface is decidedly serrated. On the contrary, hair, though sometimes curled, has its surface only scaly or rugose and never truly serrated, and hence it is that hair, though it will entangle and harle, will not felt into a compact mass. As respects chemical composition, hair and wool are alike."

Mr. Walter S. B. McLaren, M.P., states :—

"A fibre of wool may, in fact, be likened to a serpent's skin or to a fir-cone covered with scales. When spun, these, to some extent, fit into or catch each other and help to bind the fibre together, and hence, other things—such as length, quality, etc. —being equal, wool which has many serratures will spin better than wool which has few."

Under the microscope it will be found that fine merino has some 2,400 serrations to the inch, while the finest quality of all, namely Saxony wool, has 2,722. The coarser the wool, the fewer the serrations and therefore the lower the felting properties, or, in other words, they are smoother and do not cling together so easily.

Wool fibre consists of three main parts :—

(*a*) The outer scales ;
(*b*) The inner bark or cortical substance ;
(*c*) The medullary or central portion.

These external scales form the sheath of the fibre, and their dimensions, soundness, compactness and uniformity determine the lustre, strength, etc., of the wool. They, too, fix the felting properties of the fibre. The interior of the filament consists of spindle-shaped cells, and upon the density of them the elasticity of the wool depends. It is this part of the fibre which possesses the greatest affinity for colouring agents.

The central or medullary part of the filament consists of layers of oval cells, which form the pith or core of the fibre. Sometimes they run its entire length, but may occur only at intervals. Their exact functions in the structure of the fibre have not yet been determined. There are great differences not only between one breed and another as to the quality of the wool produced, but also as to the quality obtained from any individual sheep. Certain wools are much stronger than others: thus Lincoln wool is far stronger than Australian Merino, its breaking strain being some 502 grains, whereas the Australian is only 50 grains. Yet it is possible to obtain from the Short Merino a cloth capable of sustaining greater straining friction than that produced from Lincoln. The reasons for this are :—

(1) That the Merino is ranker in growth and the staple is more compact, and

(2) It has a superior felting power to the English wool.

Turning to individual sheep, we find that various grades of wool are to be obtained from the same fleece. The closest, longest, softest and most even, grows on the shoulders and sides of the animal. Wool from the neck is a little inferior, and loin and back are still lower. On the upper part of the legs the staple tends to hang considerably, while the upper part of the neck is inclined to be faulty. At the root of the tail the fibre is coarse and more glossy, while at the lower part of the leg the grease in the wool gives it a darker shade and the staple tends to twist. On the throat patches of false hair occur, and the softness reaches the vanishing point. The wool on the head is coarse, harsh and very glossy; that on the lower part of the throat and chest is similar to that on the throat itself, but shorter owing to friction against bars and fences. Wool obtained from the shin is short, glossy, coarse and, as a rule, dirty.

Main Divisions of Use

Roughly speaking, wool is employed for the production of two distinct grades of articles :—

(*a*) "Woollens," which comprise flannels, tweeds, heavy mill cloths, etc.

(*b*) "Worsteds," which represent the lighter and finer stuffs, fancy cloths and serges.

"Woollens" are produced in all parts of the United Kingdom, but chiefly in the Dewsbury and Batley districts of Yorkshire, in the neighbourhood of Rochdale in Lancashire, in

Hawick, Galashiels, on the Scotch border, and in the West of England.

"Worsteds," on the other hand, come almost entirely from the East of the Pennines in Yorkshire, Hawick in Scotland being the other main source. Bradford is, of course, the centre of the worsted industry, and four-fifths of the wool imported into England, as well as a large part of the home supply, goes to that city.

As to the materials used, "woollens" are "carded" and made principally from Merino and shorter stapled wools, while "worsteds" are generally "combed" from the longer stapled Lincoln, Leicester and other British wools. In recent years mechanical inventions have extended the scope both of the "woollen" and "worsted" manufacturer, enabling the former to use wools that would have been too long, and, at the same time, permitting the worsted manufacturer to utilize shorter wools than would have been possible half a century ago.

To-day the principal deciding factor from the point of view of the buyer is whether a wool has good felting properties or not. If it has, it is in keen demand by woollen manufacturers, and since worsteds are not matted at all, in most cases wools lacking felting qualities are equally or more suitable. It is for this reason that short and curly wools are mainly used for flannels and blankets and heavy cloths, while the longer wools are utilized by the worsted manufacturer.

CHAPTER II

PREPARATION FOR THE MARKET

THE first process in the preparation of wool for the market is that of shearing it from the sheep's back. In olden days the wool was plucked, and this system survived in Scotland till a comparatively recent date. The sheep naturally sheds its thick winter coat every year at the beginning of summer, and at such times the wool can be plucked easily and quickly ; but all sheep do not reach the same stage of shedding in the same week and much cruelty to the animals resulted, the tearing process often leaving their skins raw and bleeding. This barbarous method has now been entirely abandoned in all progressive countries, and the next stage was the hand-shears, a method still used in many parts of England. But when sheep began to be raised by the million instead of the hundred, as in Australia, it became impossible to shear the enormous number of sheep by the old hand-shearing method. To-day in Australia there are at least 30,000 professional shearers who travel across the Continent in the course of a season, and even journey as far away as New Zealand. These men are experts and earn very high wages. Whereas an English shearer using hand shears may be considered to have done a good day's work if he clips thirty sheep, these Australian shearers, with the aid of steam or electricity, will easily clip 100. The record is believed to be held by a man who sheared 327 sheep in the course of a nine-hours' day.

The mechanical shearer consists of a cutting-wheel geared to the shaft of a small steam turbine. A comb moves in front of the cutter and protects the animal from harm. The shearing apparatus proper is rather similar in shape to a small trowel, and is held in the hand and guided over the body of the sheep just as are ordinary wool shears. At the present time a shearer's daily wage is not less than 24*s.* per 100 sheep shorn, and a good man can easily earn £2 a day.

Shearing is done in large sheds, and the musterers or shepherds drive the flocks into paddocks, from whence they pass through these sheds. The fleeces come off in great strips; in fact, it would almost appear to the casual observer as if the whole fleece had been taken off at one stroke. As the wool falls from the sheep it is quickly picked up, carried away and thrown on tables. The wool rollers then skirt and roll up each fleece, placing it on the sorter's table, where an expert classifies them, and each description is placed into its own particular bin. Pressers next remove and press each kind into separate bales, and on each bale a brand is placed showing the class of sheep and the quality of wool. Shearing at one of the big stations takes from a month to six weeks, and by the end of that period the wool of some 200,000 sheep will be made up into bales and most of it on its way to the port of export. In the old days the transportation of the wool was by means of slow-moving bullock teams and tramp steamers, but methods have been so improved that it is now only a comparatively short time before it appears in the woollen mills of England.

Wool demands considerable preparation before it actually passes into the hands of the cloth weaver. Perhaps the most important process of all is that of "sorting," which demands great skill. Much time is now saved by the up-to-date methods employed in Australia, and if all wool producers adopted similar methods, time and money would be saved which is now wasted.

As already pointed out, the shearer himself in Australia makes a rough classification as he does his work. Next a highly paid expert again subdivides the clip. Each fleece contains twelve to fifteen qualities within itself, and these again are re-classified into two or three times as many. The wool grower has found that it pays him well to employ an expert at the rate of £500 or £600 a year to sort his output, as when properly classified he obtains a far better price in the wool market which more than recoups him for his original outlay. Wool classing and wool sorting may here be defined.

"Classing" is a separating of the coarse from the fine, the long from the short, the dirty from the clean, the heavy from the light, while wool "sorting" is the subdividing of the fleece of each sheep into many sorts so as to suit the exact requirements of the manufacturer. If yarn were made from all the kinds of wool produced from the same fleece, it would be faulty and difficult to work. At the present time wool is generally classed before sale, but most of the sorting is still left to the buyer. His sorter works with the aid of a wire screen or hurdle placed on an inclined desk in front of a window where the light is good. Beneath the screen arrangements are made to carry off the dust and impurities which are shaken up when the pack is first opened. These are often a source of danger to the sorter, as dirty wool is often a carrier of anthrax germs which may result in a fatal illness. It is well to note that whereas British and Australian wools are fairly safe to handle, wools from Russia, Turkey and the Far East are often infected.

As previously stated, the sorter's work is to separate the various qualities obtained from the same fleece, and one of his principal difficulties are the black and grey hairs which so often appear in white fleece. So serious a nuisance are these that the Bradford Chamber of Commerce have issued recommendations to farmers at home and abroad not to breed from black or grey sheep, but to slaughter these, using only pure white sheep for stock purposes. His other great difficulty is the number of impurities which become mixed with wool owing to the baling. Wool generally arrives from abroad in jute bags or "packs," which almost invariably leave some of the loose fibre from the packing material mixed with the wool. If this jute is not removed and gets spun into the wool it is found that it will not take the dyes. It will often bleach white and get through any combing process and finally into the cloth itself; but when this cloth comes to be dyed it refuses to take the dye and small discoloured "flecks" appear in the piece. Manufacturers have to keep special girls always at work overlooking the cloth to pick out these burrs or jute fibres.

Despite the utmost care in packing, until a bale is used which does not consist of jute, it is inevitable that a certain amount of this fibre will get mixed with the wool. A London firm has produced a wool "pack" of strong woven paper cloth which seems to answer the purpose excellently, as no deleterious fibre can rub off and mix with the wool, and even if any of the paper did get into the wool it would take the dye equally well. These paper " packs " are also waterproofed. The real difficulty is the enhanced cost of packing which they entail, and unless manufacturers are prepared to pay a higher price for wool thus packed, naturally the wool producers are not inclined to undertake the additional expense. So far, wool manufacturers do not appear willing to do so.

CHAPTER III

PREPARATION FOR MANUFACTURE

ONE of the first processes through which wool has to pass is that known as washing. Wool in its natural state is coated with a greasy substance known as the "yolk," which is washed out in the course of cleansing the fibre of the impurities which it has picked up while on the sheep's back. A warm and slightly alkaline bath is used for this purpose, but, unfortunately, it also removes the natural grease, which is a disadvantage, as a certain amount of grease is necessary for the later manufacturing processes, and at present the deficiency has to be supplied by sprinkling oil on the washed wool.

The process of washing is as follows :—The wool, blended as the purchaser requires, arrives at the scouring machine. It is carried by a travelling apron into the first "wash bowl" or trough, and is then carried forward by the periodical advance and retreat of iron forks, one step at a time, till it finally reaches the squeezing rollers and emerges from them cleaner and nearly dry. The process is repeated and the wool arrives at the last bowl. But the wool has not yet lost all its sand and vegetable rubbish. It therefore passes through the "cards" which are fitted with large cylinders, which cylinders are also furnished with bent wire teeth, and smaller cylinders working upon their circumference have other teeth of varying degrees of fineness, sharpness and strength. This machine teases out the wool into a filmy veil and frees it of most of the remaining sand and vegetable burrs, and the machine finally brings the filaments together again and passes them through a funnel to form a rope or "sliver." The wool then passes to a back-washing machine to be cleansed of any impurities which may still spoil its colour, and is dried in a hot-air chamber.

The material is oiled by measured drops of olive oil as it passes round a "gilling" machine, which straightens the fibres of the "sliver" before they pass into the "comb."

If the wool is intended for the worsted manufacturer it then enters this machine, which combs out the short and weak fibres and any last bits of vegetable impurity. It further divides the wool into two parts, "tops" and "noils," the former being the long wool with all its fibres parallel, which is the raw material for the worsted spinner, and the remainder is the short wool, which is used by the woollen manufacturers for the making of blankets, tweeds, etc. This separation of long and short is usually carried out upon a Noble comb, which is fed with "carded sliver" from balls set round the circumference of the machine near to the ground. The carded wool is thence led upwards by means of conductors to the pins or teeth of an annular comb, which rotates on a horizontal plane. This comb is generally called the "large circle," inside of which revolve two smaller circles furnished likewise with pin teeth. At the points of contact of the two sets of circles dabbing brushes work up and down pressing the uncombed wool into the teeth. The wool hangs over the edges of the circles and is caught in the comb by the passing teeth, the long fibres being drawn off and the short or noil fibres left within the pins. The "top" is carried off upwards and coiled away, while the noil is cleared out of the pin and passed downward. The combed "top" is then passed through a "finisher" box in which the "sliver" is made uniform, and has the moisture restored to it which it lost during the previous processes.

Wool combing is almost exclusively a Yorkshire monopoly, and the last returns—now completely out of date—show that there were 2,924 machine combs in the Kingdom, of which 2,642 were in Yorkshire. These were centred in or near Bradford. The wool combing is the fundamental process upon which all the subsequent processes are built, and our success as a great woollen manufacturing country is very largely due to the skill of British wool-combers. Practically nothing is wasted. The suds from the washing machines are run into tanks, where the wool grease is separated from the water by means of vitriol. The fat thus obtained is pressed under heat in special machines. The oil is run off and casked to be sold as axle grease. The pressed cakes which are left behind form a valuable manure, which is much in demand on the Continent. Even the burr dust and sand picked from the teeth of the cards is sold for shipment to France.

The process for woollens differs considerably from that of worsted manufacturers, the essential difference being that wool for worsted is combed, while that for woollens is carded. Wool intended for the woollen manufacturer is washed in very much the same way as in the former process, and after being thoroughly blended is taken to the carding machines, which consist of rollers closely covered with fine bent wire rather resembling, in looks, a rough hair-brush. These cylinders separate the fibres so minutely that when it reaches the final roller, it is spread in an even film over the whole surface. It is then combed off the wires in a single sheet so thin as to be practically transparent. These carding machines take the wool lock by lock from a bin, and drop them into a pan which extends across the machine. When the pan has received a certain stated weight the apparatus stops until the pan tips over and spreads the correct weight of wool across the feed sheet of the machine. It then repeats the former process again, doing the whole work with the utmost precision and exactitude. The film is then taken to a second carding machine, where the process is repeated and passes to a condenser which delivers the wool in a series of rings. These ropes are then sent forward to the spinner.

Spinning

This consists of twisting the fibres into rounded strands of yarn suitable for weaving. To form these, two operations are necessary. One, to draw out the fibre in a uniform and continuous manner, and the other to twist this material so as to make it cohere and resist strain, adequately. Both weft and warp are supplied by the spinner, and the difference between the two is as follows. When the yarn is first spun on to spools it is soft and fragile and can only be used while in this state for the weft. Weft is put as a cop in the shuttle and thrown lightly across the piece in weaving. Warp threads, on the other hand, must be much stronger and able to bear a greater strain, and this is obtained by giving more twist to the yarn, and worsted warps are sometimes composed of two single strands twisted together. To do this, a special frame called a "twister" is used. Yarn thus twisted has a much higher weaving value and is often used for weft as well as for warp in some of the best serges.

There are four types of spinning machines: the flyer, the cap, the ring, and the mule. According to the *Wool Year Book* classification the flyer is used for hair, lustre and low cross-bred wool yarns; the cap for the finer cross-breds and merinos; the ring for the smoother and softer yarns of the finest merino qualities; and the mule for those yarns of shorter material such as fine dry-spun dress and hosiery yarns in which special softness and fulness are required. The continuous or "throstle" frame has been adapted for wool spinning, but only to a limited extent, and the mule is still much the most popular machine for spinning every class of thread, whether it be made of pure wool or shoddy. Hand-spinning received its death-blow in 1738 by an invention by Lewis Paul, who patented a method of drawing out a "sliver" or loose coil of fibre by passing it between successive pairs of rollers, each pair revolving at an increasing rate of velocity. This principle was carried further in the spinning frame or "throstle" invented by Arkwright in 1767, and is a fundamental feature of all modern spinning machinery. The wool after combing or carding is in the form of a "sliver" or flossy rope which has to be reduced in size before it can be used either for weft or warp. To do this it is passed through a series of "boxes," the purpose of which is to extend the wool by drawing it out by means of groups of rollers. It is then twisted slightly till it resembles a loosely twisted rope, and is then wound on bobbins. This reducing process is repeated again and again until the thick uneven coil becomes a series of smooth threads. The drawing is done by rollers and the twisting and winding by means of spindles. On the mule, twisting and winding are carried out by spindles mounted in the rail of the carriage. This carriage moves backwards and forwards while the rollers are stationary and pay out the condensed thread as fast as it can be dealt with by the moving carriage with its spindles. The speed of the bobbin alters as it fills, so that it can wind wool at uniform tension throughout the whole process. When the bobbins are full of spun thread they are usually " doffed " by half-time children. Ten children can change a frame of 200 bobbins within half a minute. Automatic " doffing " is now, however, growing in use owing to difficulties attached to the use of half-timers. After spinning, a series of preliminary operations are still required before the actual weaving can be started.

Warping is the bringing together in parallel order and uniform length of the number of threads which are required for the breadth of the web which is to be formed.

Sizing, or dressing, is a process in which the warp yarn thus assembled is treated with a glutinous compound to give the threads increased tenacity.

Beaming means spreading the warp uniformly over the warp beam and then rolling it round the beam in a regular manner so as to keep the threads parallel and in straight order.

" Healding," or " drawing in," is perhaps the most important of all these operations. After being drawn through the healds the warp is passed between the splits or dents of the reed, and has then to be carried over the breast beam and the ends attached to the piece beam, when the operation of weaving proper can be begun.

Weaving

Weaving consists of interlacing warp and weft threads. In its simplest form one set of threads are passed transversely through the other, which are divided into two series worked alternately up and down so as to receive the transverse threads in passing and interlock them, thereby forming a united surface. The hand loom, which is still in use amongst semi-civilized people, and even to a considerable extent in Burma and India to-day, in England has given place to the power loom, one of the most wonderful mechanical appliances ever created. Three movements have to be observed in weaving, which are " shedding," " picking " and " beating up." After the warped threads have been made parallel, every end or group of ends, under which it is desired to thread the weft, must be raised, and there must likewise be a method of threading this weft through this open "shed" of the warp. After the shuttle has passed through, every strand of weft must be closed up to the one preceding it so that the cloth may have a firm, close texture. The warp is therefore wound round a beam which makes it possible to have a warp of any length and width, and to-day warps, hundreds of yards long and many yards wide, composed of thousands of ends, are constantly employed. The "heavy woollen" looms are so wide that the ordinary cotton loom seems a mere toy, but the looms used in the "worsted" industry are smaller and lighter and differ but slightly from the machines used in the cotton industry.

In order to divide the warp into two portions by lifting the threads so as to insert the weft, the ends of the warp are passed through the deep comb of long straight reeds which, while enabling the threads to be lifted easily, still keep them well apart. To make sure that the warp threads are lifted with precision they are passed through small loops of string known as healds, which are controlled by means of tappets in the case of small patterns and by harness cords worked by the Jacquard machine in the case of larger and more fancy patterns. These methods enable the warp threads to be opened and closed at will so as to accommodate the shuttle as it passes backwards and forwards across the cloth. By alternating the lift of these healds many kinds of weave are possible. The next movement is to beat up the weft threads against the thread immediately preceding it so as to form a close and fine texture. In the old hand loom days this beating up was done by hand, and is still so done in countries like Burma where hand-weaving survives, but in the modern factory the reed and frame to which it is attached works backwards and forwards from the cloth automatically after the shuttle has passed through the weft.

The weaving of woollens does not call for very complicated machinery as the products are chiefly plain substantial cloths, but in worsted cloth weaving, where variety is essential, many complicated movements are necessary. With two shifts of healds in the loom only a plain web can be produced, with three a simple twill, and coloured patterns may necessitate the employment of warps of different colours, and these patterns may be further diversified by using a number of shuttles each carrying a different coloured weft.

The Jacquard apparatus deserves a little more description. In the ordinary process of weaving, the warp threads are each passed through a small loop in the lifting thread so that they can be raised by means of treadles which act upon the lifting bars. In the Jacquard apparatus these lifting threads are attached to wires ending in hooks which are caught and raised by each upward motion of the lifting bar. The method of controlling the threads consists of needles acted on by healds in a card cylinder in a method similar to that of a perforated card in a musical box. There are many types of these machines, but this explanation must suffice. It is enough to say that it is now possible for the most intricate patterns to be woven with almost as much ease as a piece of plain cloth. It derives its name from the inventor, Joseph Marie Jacquard, a native of Lyons, who invented the original machine in 1801. In recent years Bradford manufacturers have tended more and more to adopt the automatic loom for the plainer kind of goods, the Northrop invention being, perhaps, the most popular. This was invented by a Keighley man who had emigrated to America. It feeds itself with weft automatically and has a warp stop attachment whereby the loom stops simultaneously with the breaking of a thread. On looms with the Northrop weft changer and warp stop motion combined a competent weaver can produce from three to six times as much as on a small plain loom. Perhaps the greatest advantage of all is its prevention of the damage done from warp thread breaks. If the machine continues working when a thread is broken, the broken end may easily get tangled around adjacent warp threads and spoil several inches of cloth.

Another type of automatic loom is of Swiss origin, and one of its specialities is that whenever it stops either through weft or warp breakage or any other reason, a small electric lamp is immediately lighted to attract the attention of the weaver. It is stated that in many Continental cotton mills in which it has been installed only three attendants are now required to look after 100 looms. It may seem strange, at first sight, that the automatic loom has not been more generally adopted in the woollen trade, but to do so involves a heavy capital outlay as well as the scrapping of looms which are still doing useful work. Its opponents are also exceedingly doubtful whether the advantages are worth this expenditure in view of the comparatively small proportion of thread breakages and other disadvantages still attached to the old looms. Some of the most important woollen manufacturers still prefer to use the old plain loom for their finest products, as they consider that the personal supervision which they necessitate in the long run leads to the best results.

CHAPTER IV

FINISHING PROCESSES

AFTER the piece of cloth has been woven it undergoes a series of operations known as "finishing." In the case of the more complicated "worsteds" the cloth passes inch by inch under the microscopic inspection of young women who are specially trained for this work. Knots are cut off where the broken yarn has had to be joined together and defects are made good with a needle and thread. The cloth has then to be washed, as it has become, in the course of manufacture, stained with numerous grease spots. It is then very often "milled," which means that it is pounded while still saturated with soap, the effect of which is to close up the fibres which shrink the cloth to the required width. This process has the further advantage of strengthening the cloth and increasing its wearing value by forcing the fibres into still closer relation. If a nap is required it is raised on the surface by teazles;—the cloth is steamed, stretched, brushed, and cropped by a fine machine which acts on the principle of the lawn mower. After this it is pressed between short plates and dry-steamed to impart a bloom. Then it is rolled into a piece and sent to the piece-room where it is once more inspected, and measured and packed for transport. Even this elaborate process is really only the skeleton. In the case of the finest materials many other processes are required. Thus, for example, cloth may be raised and cropped two or three times in succession and milled over and over again.

We now come to the dyeing process. Formerly, nearly all woollens were dyed after leaving the loom, but to-day the usual practice is to dye the yarn before spinning, as this method ensures absolute accuracy of shade in all the cloth made from the yarn. Until about fifty years ago the dyes used are obtained from natural sources and barely exceeded a dozen of first-rate importance. Among these were indigo, logwood, cochineal, etc. In 1858, Perkin obtained mauve from the coal tar product and thus started the synthetic dye industry, but, as is often the way, a prophet is not without honour except in his own house and among his own people, and instead of the industry being developed in England, it passed to Germany, which, at the outbreak of War, was producing over 2,000 different chemicals used as dyestuffs. Our almost complete dependence on Germany for these dyes was, as is well known to every one, a great source of difficulty to us in the early period of the War, and determined the Government to encourage the production of dyes in England, and to make them a key industry.

The processes involved in the fixation of different dyes vary according to chemical and other properties thereof. Direct dyes explain themselves, and acid dyes are those which will dye the material after the addition of a certain amount of acid. Other kinds must be chemically "reduced" before they can be fixed upon the wool, as they are not soluble in water. These are the so-called vat dyes, of which indigo is perhaps the best known example. Mordant dyes are another important group. These are not complete colours, but must have a chemical compound with some boric salt, before the actual colour is obtained. The direct dyes are applied by simply boiling the wool in their solution for about one hour. The acid dyes are similarly applied, but with the addition of a small amount of sulphuric, ascetic or formic acid. The insoluble vat dyes are "reduced" by combining them with hydrogen, such as hydrosulphide of soda, and alkali is required to dissolve the new compound thus formed. The wool is saturated with the warm solution and then exposed to the air, when the reverse change takes place and the original dye is reproduced on the fibre. In the case of mordant dyes, two operations are required. The wool is first boiled with a solution of the metallic mordant, usually bichromate of potash, and then in a separate bath this wool is re-boiled with the dyestuffs. The "fastness" of dyes varies considerably. For example, dyes on window curtains must be more fast to light than they would be to washing, whereas material used for underclothing requires exactly the reverse. In short, modern dyeing is a highly technical profession and requires long training.

Another important section of the work which should here be noted is that of the designer, and British designers have achieved a world-wide reputation so far as the woollen and worsted trades are concerned. At Bradford, the centre of the wool industry, a very fine Art Museum and Designing School exists which has done much to keep our wool trade abreast of modern movements. To sum up the situation, we may say that the machinery used has been, in the last fifty years, improved almost out of recognition, and there is only one serious problem which still appears to baffle the wool industry, and that is, how wool can be washed out without extracting the natural grease. Perhaps it will be of interest to note that some thirty years ago Bradford seemed to be in jeopardy of losing her main industry which was passing away to the French. Her citizens therefore opened an exhibition where they could show the world their skill and workmanship in the wool industry, but the success of the exhibition did not depend on the exhibits shown or the speeches made, but upon the short speech of a machine maker, who pointed out that he was at that moment supplying France with far more up-to-date machinery than that being used by English wool manufacturers. The lesson was taken to heart, and Bradford practically re-equipped the whole of its factories, with the result that to-day it leads the world so far as wool manufacturers are concerned.

CHAPTER V

MARKETING WOOL

WOOL was sold at Wool Exchanges, not only in London but also in various parts of Australia, the most important there being that in Sydney, and just before the War the tendency of the foreign buyers to go to Sydney to purchase supplies of wool was becoming more and more marked. The War has checked this tendency and concentrated the whole supply of Australia in the hands of the British Government which purchases direct and then re-sells to the industries of the United Kingdom. In view of the fact, however, that the large runs are being cut up by the Government and the number of smaller men are increasing rapidly, there seems little doubt that these local markets will tend to increase in importance, as it is more convenient for the small men, as a rule, to sell locally than to wait until their goods can be disposed of in London.

The principal markets in Australia at the outbreak of the War were Sydney, Melbourne, Geelong, Adelaide, Fremantle, Brisbane, and there are also markets in Tasmania and New Zealand. In 1913 these local markets dealt with quite three-quarters of the Australasian output ; in fact, in recent years Sydney alone has almost equalled London in the quantities of wool sold. The wool sales in London were tending to consist more and more of sales of wool from the Cape, Falkland Isles, and other areas outside Australasia. The largest buyers of Australasian wool were the Germans, who, in 1912, bought 420,788 bales as compared with Britain's 392,519. Further than that, the very best qualities of wool were tending to go to America rather than the United Kingdom, and Japan also was becoming a keen competitor for the higher priced wool obtainable from the Sydney salesmen.

Despite these facts, which included the growth of important Wool Exchanges on the Continent and in South Africa, the London wool sales still furnish the standard price all over the world. The actual process of selling wool is by auction, and exciting scenes in the old days were often witnessed. The sale-room itself resembles the lecture theatre of a hospital, and is quite different from the Cotton Exchanges where the dealers meet on the floor of the house and transact their business standing. Each wool salesman has his particular seat and the members sit round in crescent form, with the auctioneer enthroned in the centre. Excitement waxes high at times, and some of the scenes which have taken place there have led to the title of a "dog fight" being applied to the Sydney Exchange. The greatest Wool Exchange is situated in Coleman Street, London, where all kinds of wool, from practically every important wool-producing country in the world, were offered for auction in pre-war days, about six times a year. The wool is packed and graded on the same lines. The largest buyers go there to compete for each purchase, as they know that on the London wool market they have the best chance of obtaining any kind of wool they require. The first auction of wool from the Colonies was held on August 17, 1821, when 329 bales of wool from New South Wales, consigned by that pioneer of Australian sheep-raising, Captain MacArthur, were offered at Garraway's coffee house in Change Alley, Cornhill. One lot realized the extraordinary high price of 10*s.* 4*d.* per lb., and was purchased by a man named Hirst of Leeds. At the same time, lots were offered which came from the Cape of Good Hope, from Italy and from Spain. Before the War there were six series of sales held at Coleman Street, each of which lasted some fifteen or sixteen days, and an average of 1,200 bales of wool were sold daily.

It is worth noting, in passing, that in 1912, although England had as many sheep as New Zealand and the clip was about 180,000,000 lb. of wool, practically none of it was offered at the London Wool Exchange, the explanation being that it was purchased locally by country wool dealers acting in the interests of the West Riding trade.

CHAPTER VI

WOOL RESOURCES OF THE EMPIRE

Summary of the World's Wool Supply

THE number of sheep in the world at the end of 1913 as estimated by the National Association of Wool Manufacturers and set out in the *Wool Year Book* was as follows :—

United Kingdom	31,082,461
Other European Countries	148,433,976
Total (Europe)	179,516,437
Australia and New Zealand	117,011,654
Asia	110,058,874
Africa	51,429,279
North America	59,047,680
South America	109,693,142
Total (World)	626,757,066

and the probable total weight of raw wool before washing was 3,000,000,000 lb. After washing this would be reduced to about half.

Captain C. E. W. Bean, in a paper read before the Colonial section of the Royal Society of Arts, and taking Dalgety's figures as a basis, pointed out that of the 615,000,000 sheep of all classes, which that authority gives as the world's total, 93,000,000 were in Australia, 24,000,000 in New Zealand, and 22,000,000 woolled sheep in South Africa ; or, in other words, that these three British States in the Southern Seas, which 100 years ago possessed hardly any sheep at all, now aggregate some 139,000,000, or by far the most important section of the world. If, in addition to this, we added the 4,000,000 valuable Angoras of the Cape, the 30,000,000 sheep of the British Isles and the numerous flocks of Canada and the Falklands, the total for the whole British Empire of Dalgety's figures would be nearly 180,000,000, this despite the fact that we have excluded the sheep of British India which include a number of valuable woolled sheep, although the majority are unwoolled, and the unwoolled sheep of Africa. In other words, we held nearly one-third of the world's sheep in numbers, and very much more than that proportion so far as the value of their wool is concerned.

(A) AUSTRALASIA

By far the most important British wool-producing area is, of course, Australia. The foundation of the industry is due to the foresight of a Captain MacArthur, of the 102nd Regiment, stationed at Sydney during the opening years of the nineteenth century. He commenced by obtaining from Calcutta thirty Bengal sheep, but even this simple procedure took him three years to accomplish. When they arrived, they were described as not having an ounce of anything like wool upon them. The Captain, however, crossed them with one or two Irish sheep which he managed to obtain, and the offspring had a fleece which was distinctly more like wool. He thereupon decided to try and obtain a few Merinos. A Mrs. Gordon, widow of a colonel in the Dutch East India Company, had a small flock of these at the Cape, and MacArthur persuaded two sea captains to bring back as many as they could obtain. They brought back twenty-six. MacArthur was only able to obtain eight, but with these and his Bengals he laid the foundation of Australia's flocks. Since this time, the improvement in the quality of the sheep has been most striking. In MacArthur's day the Merino fleece weighed about 3½ lb., whereas to-day a good sheep averages 8½ lb. of fleece. About 85 per cent. of the total Australian flocks are various types of Merino. They range from small-framed, dense-woolled, fine quality sheep from Tasmania to the big-framed stronger-woolled Merino from South Australia. The remaining 15 per cent. are cross-breeds, whose development is due to the increasing export trade in mutton. Of all these cross-breeds perhaps the Lincolns are the most numerous, followed by the Leicesters, Shropshires, Southdowns, Romney Marsh, etc. Many of these long-fleeced sheep, when crossed with Merinos, produce an animal from which a good quality wool is obtainable, and at the same time a useful carcase.

The Australian climate has modified the Spanish fleece, which has become softer and more elastic. While it has diminished in density, it has increased in length and weight. The area suitable for the production of Merino comprises almost all Queensland and New South Wales, west of the dividing range, with the exception of the tropical area east of the Gulf of Carpentaria ; almost the whole of Victoria excepting the heavy timber tracks of the south-eastern division, and certain areas in the south-western division ; about two-thirds of South Australia and most of Western Australia excepting the northern and north-western coast. Even in the Northern Territory there are extensive tracts suitable for sheep-raising. On the other hand, while many areas are nominally suitable for sheep-raising, the lack of adequate water supply renders them of little use.

Altogether there are about two million square miles of land in Australia which should be capable of carrying sheep on natural pasture during normal seasons. In some areas considerable difficulty was found owing to the fact that whereas for two or three years there would be an abundance of food, a drought would come and cause the loss of a million sheep. This difficulty is now being met by the boring of Artesian wells, and an additional advantage derived from these wells is that by placing them at convenient distances it is now possible to drive the sheep through districts where formerly it was impossible.* It was in 1860 that Australia really won her position as a great wool-producing area. In that year she had some 20,135,000 sheep ; by 1880 these had increased to

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* There are, unfortunately, signs that the flow from many of these wells is diminishing ; if this cannot be remedied it will be a serious matter. See my paper on Wool, read before the Textile Institute.

62,186,702 ; in 1890, 97,881,221 ; but in 1902, the year of the great drought, this huge total was reduced to 53,668,347. Since this serious set-back, however, the numbers have steadily risen until in 1913 there were 85,049,697, during 1915 and 1916 they again decreased owing to drought, but by 1917 they were back at 84 million.

Of the various States of the Commonwealth, New South Wales is by far the most important, containing some 40,000,000 sheep, and, indeed, she is the biggest State, so far as wool-producing is concerned, in the whole world. Queensland comes next with nearly 22,000,000. The annual value of the Australian wool exported is at least £31,000,000. Formerly, the bulk of the output was sent to Great Britain for disposal, but just before the War a tendency grew for the buyers of various countries to visit Australia and buy at the local sales. Nevertheless, despite this tendency, the quantity of Australian wool sent to England represented 45 per cent. of the total imports of wool into this country. France was the next largest buyer of Australian wool, and the average import is about £6,000,000 worth, including scoured and greasy wools. Germany was the third largest purchaser, buying annually about £5,000,000 worth, while Belgium bought about £2,500,000 worth annually.

New Zealand has developed in a very similar manner to Australia, and almost every kind can be produced. In the hilly country of the South Island the Merino has been bred for many years, and was the foundation of the cross-breed stock which has made Canterbury mutton famous on the British meat market. Of late years this cross-breed has consisted of a cross between a Lincoln ram and a Merino ewe, although formerly the English Leicester was the favourite ram employed. In the North Island the moist climate suits the Romney sheep, which is the most popular breed kept, and is now tending to increase also in the South Island. The Lincolns and Border Leicesters abound in both Islands, as also does the South Down. English Leicesters are still the most popular British sheep in the southern areas. In 1913 the total was 24,189,110, an increase of 27·63 per cent. since 1903. Of the provinces, Wellington has the most sheep, Otago next and Canterbury third. The total value of the export of wool from the Dominion in 1913 was about one-third of the total value of all exports, the actual figures being :—

Total exports of New Zealand produce	£22,577,890
,, ,, ,, ,, wool	£8,057,620

The quantity exported was 186,533,036 lb., a slight decrease from that of the previous year, the exact decrease being 1,828,754 lb. It will thus be noted that, despite the fact that there has been an increase in the number of sheep kept, there has been a falling-off in the wool exported, due to the fact that the Dominion is tending more and more to breed for mutton instead of wool, and this is further proved by the fact that 93 per cent. of the New Zealand crops consist of cross-breeds, the carcases of which are suitable for freezing, for which the Merino is not suitable. During the year ending March 31, 1914, 4,019,831 sheep and 4,338,180 lambs were killed for food purposes. Of these, 2,557,639 carcases of sheep and 3,854,348 of lambs were exported. In addition to this, the average consumption of mutton, including Maoris, was 100 lb. per head. New Zealand supplies more frozen mutton and lamb to the United Kingdom than do either Australia or South America. To briefly sum up the situation, the number of sheep in 1917 were as follows :—

Queensland	21,786,600
New South Wales	39,842,518
Victoria	12,113,682
South Australia	5,140,166
Western Australia	4,418,402
Tasmania	1,745,356
New Zealand	24,191,810

making a grand total for Australasia of 109,238,534.

Before closing this chapter it is well to point out again that during the War the English Government obtained complete control of the sale of wool from our Dominions, and this has tended to bring back the sale of wool to England away from Australia. How long this procedure will continue, it is difficult to say.

Incidentally, it may be mentioned that many millions of pounds of greasy and scoured wool are shipped to the other

EXPORTS OF WOOL FROM AUSTRALIA AND COUNTRIES TO WHICH CONSIGNED: 1913–1917.

(*From Official Statistics.*)

WOOL (GREASY).

Countries to which Exported.	Quantities.				Values.			
	1913.	1914–15.	1915–16.	1916–17.	1913.	1914–15.	1915–16.	1916–17.
	lb.	lb.	lb.	lb.	£	£	£	£
United Kingdom	185,387,090	319,614,694	202,384,381	283,446,361	7,646,101	12,267,050	9,761,841	18,608,395
Canada . .	88,916	951,452	453,950	727,923	5,361	41,461	31,631	59,445
India . . .	501,827	443,451	198,228	297,218	20,707	21,182	8,564	37,790
New Zealand .	101,104	541,513	11,059	—	4,434	19,729	574	—
Other British Countries .	—	—	—	—	—	—	—	—
Austria-Hungary . . .	11,731,933	829,746	—	—	514,816	41,948	—	—
Belgium . .	51,881,724	2,984,856	—	—	2,009,209	114,826	—	—
France . . .	159,782,827	12,787,863	13,746,706	12,254,213	6,087,941	517,693	841,704	840,750
Germany . .	94,068,893	3,036,083	—	—	3,873,192	135,378	—	—
Italy . . .	5,778,424	18,191,774	43,167,206	25,608,163	243,717	669,074	1,746,303	1,539,079
Japan . . .	7,199,671	22,670,413	34,725,863	16,839,727	326,609	878,619	1,732,770	1,249,973
United States .	14,666,551	61,731,511	115,112,628	16,174	735,923	2,759,368	6,115,170	776
Other Foreign Countries .	247,918	170,474	1,452,965	32,471	‡11,772	10,309	*89,704	*3,612
Total . .	531,436,878	443,953,830	411,252,986	339,222,250	21,479,782	17,476,637	20,328,261	22,339,820

* All to Russia.

‡ Includes Egypt, £6,037.

EXPORTS OF WOOL FROM AUSTRALIA AND COUNTRIES TO WHICH CONSIGNED: 1913–1917.

WOOL (SCOURED AND WASHED, INCLUDING WOOL TOPS.)

Countries to which Exported.	Quantities.				Values.			
	1913.	1914–15.	1915–16.	1916–17.	1913.	1914–15.	1915–16.	1916–17.
	lb.	lb.	lb.	lb.	£	£	£	£
United Kingdom	26,176,484	48,171,821	37,569,727	46,917,307	1,810,535	3,146,124	2,847,130	4,823,547
Canada . .	—	95,944	180,121	173,152	—	8,602	21,685	17,822
India . . .	100,434	135,408	240,663	299,060	9,879	9,557	23,878	50,070
New Zealand .	11,042	1,879	104,864	—	765	233	4,357	—
Belgium . .	5,269,908	920,506	—	—	377,683	72,929	—	—
France . . .	18,804,399	2,154,275	1,190,494	1,016,397	1,341,915	177,058	110,322	122,347
Germany . .	10,135,857	1,748,008	—	—	819,965	159,998	—	—
Italy . . .	188,298	655,302	4,920,545	2,651,922	13,001	47,186	369,588	306,782
Japan . . .	3,564,433	6,141,036	7,499,571	5,081,183	408,409	623,957	854,321	1,220,441
Other Foreign Countries .	199,231	4,925,112	28,180,066	548,079	†15,128	§379,901	‡2,294,549	‖72,50
Total . .	64,450,086	64,949,291	79,886,051	56,687,100	4,797,280	4,625,545	6,525,830	6,613,518

† Includes United States, £9,431. ‡ Includes Russia, £28,417.
§ Includes Russia, £20,214. United States, £350,933. ‖ Includes Russia, £59,772. United States, £12,737.

EXPORTS OF WOOL FROM NEW ZEALAND AND COUNTRIES TO WHICH CONSIGNED : 1913–1916.

Countries to which Exported.	1913.	1914.	1915.	1916.
	lb.	lb.	lb.	lb.
United Kingdom	168,153,780	195,612,290	183,011,230	164,452,392
Canada	872,260	906,829	2,881,566	2,508,349
Australia	1,292,548	272,269	1,579,063	555,881
Belgium	308,551	695,850	—	—
France	4,254,506	5,686,732	—	4,369,748
Germany	6,907,786	10,305,579	—	—
United States	4,681,967	5,014,714	6,113,073	13,438,854
Japan	61,638	1,821,999	2,998,791	2,182,035
Other Countries	—	154,636	—	—
Total Quantities	186,533,036	220,472,898	196,583,723	185,507,259
Total Values	£8,057,620	£9,318,114	£10,387,875	£12,386,074

QUEENSLAND EXPORTS OF WOOL AND VALUES FOR NINE-AND-A-HALF YEARS.
(From "Queensland Sheep and Wool Industry," issued by the Queensland Government.)

Exports of Wool.	Quantity.			Value.		
	Interstate.	Oversea.	Total.	Interstate.	Oversea.	Total.
GREASY.	lb.	lb.	lb.	£	£	£
1907	26,874,174	34,094,787	60,968,961	1,094,716	1,423,434	2,518,150
1908	28,161,288	38,795,587	66,956,875	993,531	1,470,638	2,464,169
1909	28,033,874	48,668,515	76,702,389	1,005,429	2,047,295	3,052,724
1910	*	64,591,609	*	*	2,740,149	*
1911	*	78,529,887	*	*	3,081,062	*
1912	*	74,239,496	*	*	3,012,654	*
1913	*	90,229,443	*	*	3,681,663	*
1914	*	30,358,018	*	*	1,334,615	*
1914–15	*	78,206,793	*	*	3,058,035	*
1915–16	*	52,620,768	*	*	2,511,222	*
SCOURED.						
1907	8,953,367	11,660,288	20,613,655	722,987	891,993	1,614,980
1908	7,859,486	15,669,193	23,528,679	566,009	1,109,580	1,675,589
1909	8,885,474	15,288,131	24,173,605	619,453	1,139,120	1,758,573
1910	*	18,906,725	*	*	1,438,275	*
1911	*	20,524,607	*	*	1,438,071	*
1912	*	16,581,495	*	*	1,262,866	*
1913	*	20,064,779	*	*	1,552,256	*
1914†	*	5,251,469	*	*	414,307	*
1914–15	*	17,589,369	*	*	1,335,150	*
1915–16	7	16,268,471	*	*	1,410,708	*

* Not available. † First six months only.

States of the Commonwealth every year, and from thence exported oversea. No official record of these interstate transactions have been kept by the Commonwealth authorities since 1910; consequently, Queensland does not get the fullest measure of credit for her oversea exports in this direction.

According to Dalgety's *Annual Review*, the oversea exports for the past five wool seasons were as follows :—

1912–13. lb.	1913–14. lb.	1914–15. lb.	1915–16. lb.	1916–17. lb.
81,743,794	127,414,133	89,283,960	69,903,781	70,980,714.

The following are the average export prices of wool for the past ten years, as published by the State Government Statistician :—

PER LB.

	1907.	1908.	1909.	1910.	1911.
Greasy	10*d.*	8⅘*d.*	9½*d.*	10⅕*d.*	9⅖*d.*
Scoured	18⅘*d.*	17*d.*	17½*d.*	18¼*d.*	16⅘*d.*

	1912.	1913.	1914,	1915.	1916.
Greasy	9¾*d.*	9⅘*d.*	10½*d.*	9⅖*d.*	11½*d.*
Scoured	18¼*d.*	18½*d.*	19*d.*	18⅕*d.*	20¾*d.*

(B) THE WOOL RESOURCES OF GREAT BRITAIN

In 1913 the United Kingdom owned 31,082,461 sheep. The average output of Great Britain is estimated at 188 million lb., of which about 96 million was consumed locally, and the rest exported, though quite probably in the form of tops or yarn.

The net Imports of the United Kingdom in 1913 were 494,000,000 lb., and our total consumption was 590,000,000 lb. This, however, only covers raw wool; in addition, a large quantity of mohair, shoddy, etc., were utilized, the total consumption of all these kinds of allied materials being quite 872,000,000 lb. Our total consumption was increasing rapidly before the War, and during the War it still further increased, not only owing to the temporary demands for military clothing, etc., both for ourselves and for the Allies, but also for other reasons. Now that the War is ended, it seems probable that there is a bigger demand than formerly for woollens, not so much pure woollens as wool mixed with cotton. At the same time there is unquestionably a falling off in the supply of wool, which will be dealt with at a later point.* And, therefore, the Wool Industry, like the Cotton Industry, is threatened with a shortage of wool material, which at present is felt in the form of enhanced prices, and later may become so marked as to interfere with production.

In England, wool raising has not been made so scientific an occupation as it has in Australia. The English farmer, for the most part, goes in for mixed farming, among which the raising of sheep is only one of several sources of income ; and even in raising his sheep he thinks quite as much, if not more, of the carcase than of the wool. The shearing of the sheep is therefore not done on so large a scale, and therefore cannot be done so scientifically as it is in Australia. Shearing is mainly done by hand, but the greatest disadvantage under which the wool production in England suffers is the lack of adequate classing and sorting in its early stages. This naturally means that the farmer does not obtain as high a price as he otherwise could do. Furthermore, as already pointed out, the English wool does not reach the great wool market in London, but is disposed of locally. Representatives of the West Riding trade and country wool dealers either buy the wool direct from the farmers, or the wool is sold at Fairs such as those held at Lincoln, Dublin, Edinburgh, Glasgow, etc.

Constant complaint is made that British wools are badly shorn, badly classed, badly baled, the methods employed being exceedingly primitive. If we compare the prices obtained for English wool when marketed on the usual lines, and those obtained for Colonial wool of a similar class on the London wool market, we can see at once that the more highly organized methods used in the Colonies for classifying and packing ensure a better financial return to the growers.

In recent years various co-operative wool societies have been started in different parts of the country, and the Agricultural Organization Society has played an important part in encouraging the adoption of those parts of the Colonial system most suitable for Great Britain. In particular they have aimed at a proper classification of the wool, and its subsequent sale in large lots, under brands constituting a guarantee of the quality in the bale. It will be remembered that the inferior portions of the fleece, such as the skirting, have a marketable value, but they should be marketed separately; and it is because the Colonies have done this that they are able to obtain higher prices for their first-grade wools, since the buyer knows that if a bale is marked as being of the finest quality, it will be found so throughout.

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* See my paper read before the Textile Institute.

The success of the Brandsby Agricultural Trading Association, which in 1914 sold considerable quantities in London, proved that this method is most advantageous to the grower. The first lot sold was some 93,071 lb., which realized £4,521 7*s.* 2*d.*, and the senders considered that the lower and medium grade realized quite as much, if not more, and the higher grades considerably more than they would have done if sold locally. The Yorkshire manufacturers bought it at a higher price per lb. than that which was being given by the dealers at the very same date who were buying direct from the farmers in Yorkshire. The War has greatly encouraged farming throughout the whole Kingdom, and in the general prosperity which now seems to be coming to agriculture, wool raising will benefit directly by the bigger demand for local produce, and indirectly by the fact that farmers are now in a better position financially to organize and classify their wool production and sale.

As the result of a special inquiry undertaken by the Board of Agriculture and Fisheries in 1908 the clip of wool in Great Britain was estimated as follows:—

Washed	56 million lb.
Unwashed.	32 ,, ,,
Total	88 ,, ,,

of about a value of £2,600,000. In addition, the yield of wool from sheep, slaughtered, was estimated at 22,000,000 lb., making the total of the wool produced in Great Britain

110,000,000 lb., of a value of about £3,100,000 (Cd. 6277, p. 13).

The Irish yield of wool in 1908 was stated at 15,000,000 lb., of a value of £430,000. On the basis of these figures the total production of the United Kingdom was 125,000,000 lb., of a value of nearly £3,500,000, but it is not clear whether the Irish statistics include the wool obtained from sheep slaughtered. The net value of the import of sheep and lambs' wool into the United Kingdom in 1908 was about £15,150,000.

(C) OTHER BRITISH AREAS

The following British areas are also deserving of special attention :—

(1) Africa.
(2) India.
(3) Canada.
(4) Falkland Isles.

(1a) SOUTH AFRICA

The original Cape sheep, which is still bred to a large extent in South Africa, is a light, somewhat leggy creature covered with hair of varying colour and having long lopping ears. In short, it is very similar to the ordinary sheep found in most parts of India. Its peculiarity consists in its broad tail composed chiefly of fat varying from 6 to 10 lb. In order to improve the native sheep, rams and ewes of the best flocks in Holland were imported by the Dutch East India Company in 1654. In 1689 a certain number of Spanish sheep were introduced. In 1790, Colonel Gordon, an officer in the Company's service, obtained a number of fine merino of the Escurial breed. It was from this flock that Captain MacArthur obtained his merinos for Australia. In 1820 a number of English breeds were introduced, and later rams from Saxony and France were obtained. In more recent years rams have been obtained from Australia. The aim of those who control the industry in the Union has been to build up by means of careful selection a pure breed of merinos. The number of sheep, woolled and other, in the country, was as follows :—

* NUMBER OF SHEEP IN UNION, 1904, 1911 AND 1916.

Province.	1904.	1911.	1916.†
Cape of Good Hope	11,818,829	20,005,826	16,559,418
Natal	780,297	1,519,258	2,300,293
Transvaal	835,749	3,360,688	4,493,417
Orange Free State	2,999,547	8,587,638	8,627,577
Total	16,434,422	33,473,410	31,980,705

* The following details are mainly drawn from the official publications of the Union.

† In 1918 there were only 29,900,000.

According to the returns for 1916 the percentage of woolled sheep to cross-bred and others was 82·83 per cent. Between the years 1912 and 1916 considerable loss was experienced in some localities owing to drought and disease, but in 1916 there was a marked improvement, which will doubtless be reflected when later returns are available.

Average Number of Sheep per Square Mile

The following table gives particulars of the average number of sheep per square mile in several Provinces :—

AVERAGE NUMBER OF SHEEP PER SQUARE MILE, 1911 AND 1916.

Province.	1911.	1916.
Cape of Good Hope	72·19	52·46
Natal	43·05	65·20
Transvaal	30·43	40·69
Orange Free State	170·42	171·28

Wool Production

Almost the whole of the Union wool clip is shipped oversea, and the export returns, therefore, reflect practically the total production of the country. In the year 1714 the wool exported from the Cape of Good Hope amounted to 650 lb. ; in 1835 to 215,868 lb. ; in 1855 to 12,016,415 lb. ; in 1875 to 40,339,674 lb. ; in 1895 to 65,632,613 lb. ; and in 1909 to 101,007,893 lb. Similar comparative figures for the other Provinces are not available, but it will be seen from the figures given in the following table that the industry in the Cape of Good Hope during the years 1890–99 did not maintain its previous rate of progress, due principally to the effects of locusts, disease and drought :—

Wool Exported from the Cape of Good Hope, 1885–99.

Year.	Quantity.	Year.	Quantity.
	lb.		lb.
1885	34,432,562	1895	65,632,613
1890	65,655,917	1899	69,289,606

The next table shows the quantity of wool exported from the territories comprising the Union since 1905 :—

Wool Exported from Territories Comprising the Union, 1905–17.

Year.	Quantity.	Year.	Quantity.
	lb.		lb.
1905	77,187,226	1914	133,981,317
1909	130,981,518	1915	170,003,173
1911	132,207,029	1916	136,395,191
1913	176,971,865	1917	117,657,142

Trade in Wool

The increased value of South African wool in consequence of the European War is shown in the following table :—

QUANTITY AND VALUE OF WOOL EXPORTED FROM UNION, 1913–18.

Season.*	Quantity	Quantity in Bales.†	Value.	Average Price per lb.
	lb.		£	*d.*
1913–14	174,053,755	511,922	5,767,695	7·95
1914–15	146,930,843	432,149	4,293,104	7·01
1915–16	148,192,286	435,565	5,903,078	9·56
1916–17	111,468,735	327,849	7,289,739	15·69
1917–18	116,827,008	343,609	10,113,970	20·78

* August 1 to July 31. † Average weight per bale, 340 lb.

Prior to the War the bulk of the wool was shipped to the United Kingdom, where a large proportion was marketed and distributed. Since then the usual trade channels have been disturbed and the produce has been, to a large extent, diverted to other centres. The present distribution of South African wool is shown in the following table :—

DESTINATION OF WOOL EXPORTED FROM UNION, SEASON 1917–18.*

Destination.	Quantity.	Quantity in Bales.	Value.
	lb.	No.	£
United Kingdom	12,770,699	37,561	803,366
Canada	715,858	2,106	73,893
United States of America .	68,564,860	201,661	6,274,091
Japan	34,670,123	101,971	2,953,771
France	105,468	310	8,849
Total . . .	116,827,008	343,609	10,113,970

* August 1 to July 31.

During the six months January 1 to June 30, 1917, the quantity of wool exported to the United States of America represented 22,873,864 lb. (67,276 bales), and to Japan 15,127,731 lb. (44,493 bales).

Export of Sheep Skins

A considerable trade in sheep skins is likewise carried on. The following table shows the quantity and value of sheep skins exported during the years 1911–17 :—

SHEEP SKINS EXPORTED 1911–17.

Year.	Quantity.	Value.	Year.	Quantity.	Value.
	lb.	£		lb.	£
1911	23,996,966	574,457	1915	37,226,422	827,590
1912	29,029,147	724,196	1916	30,410,386	1,084,042
1913	32,196,400	889,611	1917	24,941,141	1,431,854
1914	30,353,731	753,273			

Mutton

It was formerly necessary to import large quantities of mutton for consumption within the Union, but the importations have dwindled to negligible dimensions, as will be seen from the following table :—

IMPORTATION OF MUTTON, 1911–17.

Year.	Quantity.	Value.	Year.	Quantity.	Value.
	lb.	£		lb.	£
1911	3,463,899	32,308	1915	8,881	238
1912	2,641,790	25,450	1916	5,822	179
1913	2,114,384	24,448	1917	17,581	441
1914	781,675	11,065			

In 1915 the exports of mutton (473,902 lb., valued at £9,779) exceeded the imports.

Goats and Mohair (The Angora Goat)

The first attempt to introduce the Angora goat into South Africa is said to have been made in 1825. Thirty rams and ewes were imported in 1856, and subsequent shipments arrived in 1857, 1867, 1879 and 1880. So much intelligent care and industry were applied to the breeding of Angoras that in 1891 there were approximately 3,000,000 in the country, and some of the specimens were regarded as superior to any goats produced in Turkey.

The following table gives the number of Angora goats in the Union in 1904, 1911 and 1916 ;—

NUMBER OF ANGORA GOATS IN UNION, 1904, 1911 AND 1916.

Province.	1904.	1911.	1916.
Cape of Good Hope . .	2,775,927	3,340,132	2,190,575
Natal	75,708	127,452	73,634
Transvaal	85,868	262,174	110,805
Orange Free State . .	734,169*	545,577	189,275
Total . .		4,275,335	2,564,289

* Goats of all kinds.

The severe drought which visited the country during the few years prior to 1916, especially in the districts devoted largely to the raising of Angoras, is mainly responsible for the falling off in the number of Angora goats raised since 1911.

Production of Mohair

As in the case of wool, practically all mohair is shipped oversea, and the export returns may be taken substantially as indicating the production of this article in the Union. The quantity and value of mohair exported in 1857 and in each tenth subsequent year until 1907 from the several Colonies and States now comprising the Union were as follows :—

MOHAIR EXPORTED, 1857–1907.

Year.	Quantity.	Value.	Year.	Quantity.	Value.
	lb.	£		lb.	£
1857	870	10	1887	8,756,116	268,446
1867	43,348	4,985	1897	12,055,390	676,644
1877	1,429,045	116,382	1907	18,700,306	965,687

The arrested progress with regard to the production of wool in the period 1890–1900 is equally apparent in the case of mohair. In 1891 the exports totalled 10,183,752 lb. ; in 1895, 10,354,870 lb. ; in 1899, 12,844,454 lb. ; and in 1901, 10,615,948 lb.

The quantity and value of mohair exported from the Union during the years 1911–17 is shown in the following table :—

MOHAIR EXPORTED FROM UNION, 1911–17.

Year.	Quantity.	Value.	Year.	Quantity.	Value.
	lb.	£		lb.	£
1911	24,066,825	917,874	1915	16,304,378	687,635
1912	23,479,729	967,286	1916	17,374,068	1,115,281
1913	17,355,882	876,255	1917	3,690,828	280,636
1914	18,865,743	834,202			

Trade in Mohair

To a certain extent the supply of mohair exceeds the demand, and the sale is confined almost entirely to the Bradford market, where it is spun into yarn and distributed. Until Turkey entered the European War that country was the greatest competitor with the Union in the supply of mohair. In 1865, when the mohair exported from South Africa amounted to 9,609 lb., the amount exported to the United Kingdom from Turkey totalled 2,421,188 lb.

By the year 1887 a greater quantity of mohair was being exported to the United Kingdom from South Africa than from Turkey—8,756,116 lb. as against 6,714,816 lb.—and since that year the Turkish export has only twice exceeded that of South Africa—in 1895 and in 1898. Since 1907 the annual South Africa output to the United Kingdom has been nearly double that of Turkey, and the lead has been maintained notwithstanding that average Turkish mohair commands some 2*d*. to 3*d*. per lb. more than from South Africa. The exceptional advance made in regard to other pastoral industries in the last decade did not, however, occur in the case of mohair ; for, as already stated, mohair is an article for which there is a limited demand, and the stimulus to the production of such commodities as wool, dairy produce, and ostrich feathers which came with the conclusion of the Anglo-Boer War slackened in respect of mohair as soon as the country had reached the limit of successful competition with Turkey for the world's consumption of about 30,000,000 lb. per annum, of which South Africa produces more than half. The average price per lb. obtained for mohair in the season 1913–14 was 14·83*d*. ;

in 1914–15, 9·00*d.*; in 1915–16, 12·21*d.*; and in 1916–17, 17·66*d.*

According to the returns for 1916 the proportion of Angora goats to others was 28·6 per cent.

The South African Goat

The common goat was found to be in the possession of the natives of the Cape of Good Hope when the country was first occupied by Europeans. This animal was, however, very inferior to the common goat of the country as it exists at the present day. Improvement in size and appearance has been effected by breeding. At present South African goats are bred principally in the dry Karroo districts to the north and north-west of the Cape Province, in the various native areas, and in the bush country where sheep do not thrive. These goats are hardy animals, grow to a considerable size, and multiply rapidly; hence they are the most profitable stock which can be raised in districts where there is a demand for their mutton. The following table gives the number of goats (other than Angora) in the Union in the years 1904, 1911 and 1916:—

NUMBER OF GOATS (OTHER THAN ANGORA) IN UNION, 1904, 1911 AND 1916.

Province.	1904.	1911.	1916.
Cape of Good Hope . .	4,391,536	4,613,282	3,618,148
Natal	815,953	861,822	1,171,191
Transvaal	788,133	1,509,546	1,462,156
Orange Free State . .	734,169*	502,994	145,912
Total . .	6,729,791	7,487,644	6,397,407

* Includes Angora goats.

Trade in Goat Skins

Practically all the goat skins available for sale are exported oversea. The following table shows the quantity and value of goat skins (including Angora) exported from the Union during the years 1911–17:—

GOAT SKINS (INCLUDING ANGORA) EXPORTED FROM UNION, 1911–17.

Year.	Quantity.	Value.	Year.	Quantity.	Value.
	lb.	£		lb.	£
1911	7,469,158	262,636	1915	8,304,792	264,875
1912	8,126,360	291,695	1916	8,513,363	414,777
1913	9,104,691	325,936	1917	4,462,879	362,626
1914	7,941,096	270,170			

Further details showing the sub-division of different kinds of sheep are as follows :—

Sheep

NUMBER OF SHEEP IN EACH PROVINCE, 1904–18.

Woolled Sheep.

Year.	Cape of Good Hope.	Natal.	Transvaal.	Orange Free State.	Union.
1904 (General Census) .	8,465,308	504,798	413,638	2,436,891	11,820,635
1911 ,, ,, .	11,051,836	1,105,023	2,330,304	7,355,052	21,842,215
1912 (Dept. of Agric.) .	13,239,067	1,583,659	3,098,785	9,409,656	27,331,167
1913 ,, ,, .	13,396,765	1,666,019	3,797,395	9,467,728	28,327,907
1915 ,, ,, .	12,372,344	1,938,113	3,467,206	8,166,143	25,943,806
1916 ,, ,, .	12,712,107	1,927,746	3,615,821	8,234,850	26,490,524
1918 (Census Agric.) .	13,301,626	1,279,833	2,868,425	7,608,834	25,058,718

Other Sheep.

Year.	Cape of Good Hope.	Natal.	Transvaal.	Orange Free State.	Union.
1904 (General Census) .	3,353,521	163,580	422,111	562,656	4,501,868
1911 ,, ,, .	6,082,677	414,235	1,084,946	1,232,586	8,814,444
1912 (Dept. of Agric.) .	6,022,147	295,090	1,206,251	1,034,266	8,557,754
1913 ,, ,, .	5,188,939	357,866	1,220,563	712,725	7,480,093
1915 ,, ,, .	3,886,782	406,034	811,786	385,672	5,490,274
1916 ,, ,, .	3,847,311	372,547	877,596	392,727	5,490,181
1918 (Census Agric.) .	3,572,316	320,545	614,404	348,052	4,855,317

NUMBER AND CLASSIFICATION OF SHEEP, MAY 5, 1918.

Sheep (including Lambs).

Province.	Merino.	English Breeds.	Other Woolled Sheep.	Persian.	Africander.	Total.
Cape of Good Hope	10,588,729	49,895	508,792	832,522	2,563,046	14,542,984
Natal	1,194,207	13,683	23,445	12,164	63,297	1,306,796
Transvaal . . .	2,653,702	18,851	185,890	119,632	207,150	3,185,225
Orange Free State	7,327,154	29,068	182,020	127,328	197,179	7,862,749
Native Locations, Reserves, etc. .	2,283,282			732,999		3,016,281
Total . . .	21,763,792*	111,497*	900,147*	1,091,646*	3,030,672*	29,914,035*

* Excluding Native Locations, Reserves, etc.

Lambs.

Province.	Woolled.	Other.	Total.
Cape of Good Hope . . .	2,892,523	1,226,300	4,118,823
Natal	252,927	17,676	270,603
Transvaal	615,264	99,256	714,520
Orange Free State . . .	1,901,935	122,534	2,024,469
Native Locations, Reserves, etc.	532,166	212,212	744,378
Total	6,194,815	1,677,978	7,872,793

Goats

NUMBER OF GOATS IN EACH PROVINCE, 1904–18.

Angora Goats.

Year.	Cape of Good Hope.	Natal.	Transvaal.	Orange Free State.	Union.
1904 (General Census) .	2,775,927	128,752	85,868	402,192	3,392,739
1911 ,, ,, .	3,340,132	127,452	262,174	545,577	4,275,335
1912 (Dept. of Agric.) .	3,668,581	77,673	189,747	459,100	4,395,101
1913 ,, ,, .	3,546,218	80,517	225,458	341,691	4,193,884
1915 ,, ,, .	2,396,834	79,105	122,400	246,166	2,844,505
1916 ,, ,, .	2,190,575	73,634	110,805	189,275	2,564,289
1918 (Census Agric.) .	2,391,963	66,029	109,061	164,125	2,731,178

Goats other than Angora.

Year.	Cape of Good Hope.	Natal.	Transvaal.	Orange Free State.	Union.
1904 (General Census) .	4,386,536	871,180	788,113	331,977	6,377,806
1911 ,, ,, .	4,613,282	861,822	1,509,546	502,994	7,487,644
1912 (Dept. of.Agric.) .	4,473,200	812,079	1,665,628	345,154	7,296,061
1913 ,, ,, .	4,196,694	986,675	1,752,351	275,422	7,211,142
1915 ,, ,, .	3,567,234	1,109,377	1,233,338	163,818	6,073,767
1916 ,, ,, .	3,618,148	1,171,191	1,462,156	145,912	6,397,407
1918 (Census Agric.) .	3,503,939	817,083	875,820	90,851	5,287,693

NUMBER AND CLASSIFICATION OF GOATS, MAY 5, 1918.

Province.	Goats, including Kids.			Kids.		
	Angora.	Other.	Total.	Angora.	Other.	Total.
Cape of Good Hope	2,258,946	2,164,625	4,423,571	695,367	720,275	1,415,642
Natal	56,289	169,679	225,968	13,146	37,507	50,653
Transvaal . . .	103,678	287,212	390,890	26,900	71,102	98,092
Orange Free State .	151,551	81,899	233,450	39,306	24,090	63,396
Native Locations, Reserves, etc. .	160,714	2,584,278	2,744,992	45,463	687,259	732,722
Total . . .	2,731,178	5,287,693,	8,018,871	820,272	1,540,233	2,360,505

(1b) WOOLS FROM OTHER PARTS OF BRITISH AFRICA

In addition to the supply of wool obtained from the Union of South Africa there are two other areas attached to that British possession which are worthy of mention.

(A) BASUTOLAND, BECHUANALAND, ETC.

In 1916 Basutoland exported 11,375 lb. of wool and 2,900,000 lb. of mohair. Unfortunately there were serious outbreaks of anthrax, to check which inoculation was resorted to, with apparently satisfactory results.

Bechuanaland also produces a certain amount of wool, and the local disease there is known as the scab disease, and considerable attention is now being paid to its prevention.

(B) EAST AFRICA

In East Africa serious attempts have been made to raise an improved quality of sheep, and particularly so in the British East African Protectorate. In 1911 the number was estimated at 60,000 good-class cross-bred sheep. The merino were brought from Australia, and, by cross-breeding with the native sheep of the locality, about 1½ lb. of wool, worth 2¾*d.* per lb., was obtained from the first cross, and about 3 lb., worth about 7½*d.* per lb., from the second. The third crossing resulted in 4 to 5 lb. of wool, which was obtaining 10½*d.* per lb. The stud farm run by the East African Syndicate is near Nairobi, and the native sheep which has been found most suitable for crossing with the merinos was the Wangella type. The natives have proved excellent shearers, and a gang of ten shear about 500 head per day at a total cost of 20*s.* In addition, in the Urundi and Ruanda districts there are some 2,000,000 sheep and goats, mostly of native stock.

(C) EGYPT

The native Egyptian sheep belongs to the flat-tailed native breed found in most parts of Africa. Little attention has been devoted to them, and the process of shearing scarcely pays. The principal types produced at the present time are coarse wools suitable mostly for carpets. In 1911, 10,400 bales were exported to England, and were mostly sold at Liverpool. The wool from the Red Sea coast is even coarser than that from other parts. It is believed in official quarters that the quality of the wool could be considerably improved by judicious crossing and breeding, but the greater attraction of cotton growing has tended to discourage any scientific endeavours to improve the sheep. It is probable that it would not pay to devote land in the Nile Valley to sheep-raising, as various crops, including cotton, are likely to remain much more remunerative, but in many districts of the Sudan it should be possible to raise considerable numbers of woolled sheep, and as the difficulty in this district—so far as cotton growing is concerned—is the shortage of labour, it is to be hoped that attention will be devoted to increasing the number of sheep capable of producing wool of commercial value. The number of men required to look after large numbers of sheep is comparatively small, and this fact renders it particularly suitable as an industry in the Sudan.

(2) INDIA

Much of the wool classed as East Indian is really collected from neighbouring countries. Indian wools are usually sent to Liverpool, where they are sold by auction every two months. The principal disadvantage under which these wools labour is that they generally contain a considerable quantity of grey hair. Joria is the finest type. The best sorts produce a springy full yarn and cloth, but the lower classes are coarse and burry. Kandahar wools are good carpet wools and are utilized mainly for native Indian carpet manufacture. Kalat, from Baluchistan, is inferior and is shorter in staple than is Kandahar, and Pathan is similar. The cashmere goat wool resembles poor sheep wool. Tibet wool is brought across the frontier and sold and packed in Calcutta. It requires much sorting, and the export has increased largely in recent years since the opening up of Tibet which resulted from the British expedition to Lhasa. The Punjab Government has recently devoted considerable attention to the improvement of the indigenous breed of sheep, and merino rams, which have been introduced into one or two districts, appear to be thriving satisfactorily. The work is mainly under the control of the Civil Veterinary

Department, Lucknow United Provinces. The principal ports of export for Indian wools are Bombay and Karachi.

The statistics below and on page 225 give a fair picture of the export of wool from India, but the point should be emphasized that the bulk of these wools are low grade, and much of the wool produced in the country is not suitable for anything but carpets. It seems quite possible, however, that by judicious crossing the breeds might be so improved that in the near future India may be able to export far larger quantities of better grade wools suitable for the British looms than has heretofore been the case.

Exports of Raw Wool from India.

In Thousands of £ Sterling.

Countries.	1912–13. £(1,000).	1913–14. £(1,000).	1914–15. £(1,000).	1915–16. £(1,000).	1916–17. £(1,000).
To—					
United Kingdom .	1,705	1,621	1,542	2,502	2,519
United States . .	29	28	26	15	—
Other Countries .	22	21	11	10	1
Total . . .	1,756	1,670	1,579	2,527	2,520

(3) CANADA

There are less than 3,000,000 sheep in Canada, of which over 1,000,000 are in the State of Ontario. No very serious attempt has been made to develop the wool industry or even mutton raising in Canada, and the number of sheep have been steadily decreasing. The Eastern sheep are long-woolled, mostly Downs, and are bred entirely for their mutton. The flocks are very small, seldom more than twenty sheep in number, and are kept really as scavengers to eat out "fence corners" and so forth. The climatic conditions in the winter being very severe, winter feeding is necessary, and this, together with destruction by stray dogs and the prevalence of a considerable amount of sheep disease, has discouraged sheep-rearing, as also has been the case in the northern part of the United States.

INDIA: EXPORTS OF WOOL, RAW AND MANUFACTURED, WITH PRINCIPAL COUNTRIES TO WHICH EXPORTED.

ARTICLES AND COUNTRIES.	QUANTITIES.					VALUE.				
	1912-13.	1913-14.	1914-15.	1915-16.	1916-17.	1912-13.	1913-14.	1914-15.	1915-16.	1916-17.
Wool: (Raw)—	lb.	lb.	lb.	lb.	lb.	£	£	£	£	£
United Kingdom	51,293,915	47,489,347	43,754,991	64,501,280	48,089,323	1,704,785	1,621,111	1,542,192	2,502,251	2,518,797
Germany . .	320,465	490.974	109,192	0	0	9,136	17,026	4,633	0	0
United States .	1,180,006	808,668	620,776	334,190	0	29,391	28,019	26,203	14,726	0
Other Countries	632,182	133,072	125,328	188,282	18,341	13,136	3,490	6,311	10.321	1,075
	53,426,568	48,922,061	44,610,287	65,023,752	48,107,664	1,756,448	1,669,646	1,579,339	2,527,298	2,519,872
(Manufactures)										
(Carpets & Rugs)	lb.	lb.	lb.	lb.	lb.					
United Kingdom	1,452,783	1,354,532	793,080	1,104,753	977,694	118,642	119,641	68,526	88,040	82,167
Natal . . .	27,034	41,681	43,533	142,001	148,145	2,388	4,047	4,035	9.437	9,092
United States .	95,682	99,772	105,183	179,612	295,071	14,088	13,569	19,442	35.366	52.517
Australia . .	35,462	47,526	39,790	76,295	119,106	3,922	4,825	3,433	5,677	11,089
Other Countries	90,000	97,259	62,186	79,208	318.458	10,716	11,364	6,618	6,800	27,588
	1,700,961	1,640,770	1,043,772	1,581,869	1,858,474	149,756	153,446	102,054	145,320	182,453
	yds.	yds.	yds.	yds.	yds.					
Piece Goods . .	21,990	11,687	2,504	5,860	8,957	1,780	925	118	1,061	1,185
Shawls (No.)	11,067	5,039	2,837	3,011	3,033	4,080	2,685	925	1,163	1,184
Other Sorts—	lb.	lb.	lb.	lb.	lb.					
Ceylon . . .	277,113	321,510	304,839	373,403	339,765	6,788	7,519	6,644	9,161	10,235
Turkey, Asiatic, Persian Gulf	114,228	0	0	0	0	5,016	0	0	0	0
Other Countries	49,779	86,968	99,808	248,142	223,452	4,740	2,774	3,423	3,740	5,590
	441,120	408,478	404,647	621,545	563,217	16,544	10,293	10,067	12,901	15,825
Total, Woollen Manufs.	—	—	—	—	—	172,160	167,349	113,164	160,447	200,647
Total, Wool & Woollens	—	—	—	—	—	1,928,608	1,836,995	1,692,503	2,687,745	2,720,519

In the Western Provinces, particularly Alberta and Saskatchewan, the sheep are nearly all merino. Little care is bestowed upon the preparation of wool for the market, and recently the Dominion Government has endeavoured to remedy this condition of affairs by a system of co-operative action. In 1916, 1,721,000 lb. of carefully graded wool was sold by Associated Sheep Farmers. It is officially estimated by the Canadian Department of Agriculture that Canada could easily carry 30,000,000 sheep instead of less than 3,000,000 as at present. In 1917 a company known as The Canadian Co-operative Woolgrowers Limited, of Toronto, was formed for the purpose of marketing wools from Western Canada with the object of increasing production of the present amount, which is not more than 15,000,000 lb. annually, to at least 30,000,000 within a few years.

(4) FALKLAND ISLES

The colony of the Falkland Isles includes the Falkland Isles, South Georgia, the Sandwich Group, South Orkneys, and South Shetlands. The administration of the fringe of the Antarctic Continent, known as Grahams Land, is also centred in these Islands. They are a Crown Colony, and originally occupied by us on account of their strategic importance, being near the Straits of Magellan. After many vicissitudes they finally passed under our control in 1820. The Islands themselves are an archipelago lying between 51° S. and 60° S., and 27° 30 m. W. and 62° 35 m. W. The capital is Port Stanley, which is situated in lat. 51° 41 m. S., that is, almost identical with London in the northern hemisphere but much further west, and it stands on an inlet which forms an excellent harbour. The total area is estimated at some 10,000 square miles, excluding the Interior of Grahams Land, but the only Islands of real importance are the Falklands themselves, the other areas being utilized mainly for whaling stations during the whaling season.

The total area of the Falklands is some 6,500 square miles. The country presents much the same appearance as many parts of the West Highlands of Scotland, consisting, as it does, of undulating moorland broken in part by quartzite ridges and peaks rising above a peat-covered land.

From the point of view of wool, all the other Islands except the two main Falklands may be practically ignored. As already stated, the two main industries are whaling, which is largely in the hands of Norwegians, and sheep-raising, which is largely in the hands of English and Scotch settlers. The land supports over 700,000 sheep which have mainly been bred for the purpose of obtaining wool, although during the last few years two canning factories have begun work capable of dealing with 600 and 300 sheep daily. In 1912, 46,000 sheep were thus treated. Of the many types of wool which the Falklands produce, special mention must be made of the Cheviot wools obtained from Cheviot sheep originally introduced by early Scottish settlers.

The export of wool from the Falkland Isles to Great Britain was as follows :—

	1914.	1915.	1916.	1917.	1918.
QUANTITIES :—	lb.	lb.	lb.	lb.	lb.
	4,454,000	3,044,924	4,352,042	1,755,205	5,772,256
VALUES :—	£	£	£	£	£
	149,080	117,270	235,768	128,547	442,954

The value for the total export for 1917 was £239,727.

CHAPTER VII

WOOL-PRODUCING AREAS OUTSIDE THE EMPIRE

(A) NON-BRITISH EUROPEAN WOOLS

ALL European sheep of importance have sprung from the Spanish merino, but have been usually crossed with local varieties.

(a) ALBANIAN WOOL

Albanian wool is a well-grown, uniform wool of good staple colour and quality. It is used mainly for carpets, and the bulk of the supply is taken up locally, though in normal times a certain amount was shipped from Salonika.

(b) AUSTRIAN WOOL

Austrian wools are very similar to German wools, which see, but the wool from the Zackel fleece in Hungary is mostly utilized for the production of carpets.

(c) BALKAN STATES, ETC.

The Wallachian sheep is the kind found in most of these States. It yields a fine soft wool which is, however, considerably spoilt by the presence of many strong hairs. *Salonika wool* gains its name from the fact that it is exported from that port. It is a well-grown, uniform wool used mainly for carpets, and is always sold in unwashed fleece condition. *Adrianople wool* is a kind of inferior merino. In 1911 some 118 tons were sent to Salonika; 216 tons went to Serbia, and 246 tons to Bulgaria, the latter being used mainly for the manufacture of Army clothing. The bulk of the coarser kinds are utilized locally by the peasants in their homespun industry. *Kassapbatchi wool* is the skin wool collected from the fellmongers of

Constantinople and is divided into three grades, of which the first is equivalent to a rather low-class merino, and the others are carpet wools.

(*d*) Corsica produces a coarse combing variety which is generally grey, brown or black, with but little white in it.

(*e*) Cyprus wool amounts annually to some 200 tons, valued at about £10,000 so far as the export trade is concerned. It is believed that the supply could be increased considerably, and the quality is good.

(*f*) FRENCH WOOLS

France produces considerable quantities of wool, most of which are used, however, for the home industries. The famous Rambouillet breed have made the French merino famous all over the world, and in pre-war days large numbers of rams were exported to foreign countries, particularly South America, to improve the breeds. This breed was established in 1786 by the importation by the French Government of 367 of the finest merino sheep from Spain. The breed produced is considered by experts to be the strongest woolled and the largest and the hardiest merino sheep in the world. Merino wool is somewhat hard to handle, and in 1919 was worth about 21*d*. per kilo. (2·2 lb.) of raw wool. France also produces a number of cross-breeds.

(*g*) GERMANY

Before the War the Silesian merino was regarded as the finest wool sheep in the world. The flocks are believed to have been nearly halved during the War, largely owing to the difficulty of providing food and the proper attention required. This will be a matter of considerable loss to Germany. The bulk of German sheep, however, are merino crossed with native breeds, and there is a coarse mountain wool resembling the Scotch Blackfaced, the supply of which was, however, small. The sheep population of Germany has been steadily declining for many years before the War. In 1871 it was believed that the number was some 25,000,000, whereas by 1918 it was stated by a German Professor of Agriculture to have sunk to 5½ million. Whether Germany will now be able to re-establish her flocks remains to be seen, but even in normal times her production of wool was only some 11,000 tons, and she had to import annually about 186,000 tons.

(*h*) GRECIAN WOOL

This is a long wool of coarse quality, but suitable for combing. It is grown in the mountains between Greece and what was Turkey, and was usually shipped from the port of Volo, from which place it derives its commercial name.

(*i*) ICELAND

This island produces wool of a coarse, hairy, poor quality, but it has one peculiarity, namely, a fine, downy undergrowth which distinguishes it from other wools of a " heath " character. When the wool is combed this down passes into the noil and makes it fine and silky, whereas the long fibres or tops remain coarse and rather kempy. Iceland wool is usually " steam-washed " on the sheep's back. Some 900 tons a year are shipped abroad, mainly to Denmark and U.S.A. In 1910 some 5,700 lb. were shipped to England.

The Faroe Islands may be conveniently grouped with Iceland and, like the former, belong to the Danish Crown. In 1909 there were some 100,000 sheep and about 14,000 lb. of wool was exported. A fair amount is also used locally in manufactured yarns and knitted goods.

(*j*) ITALY

Italian production consists mainly of inferior types of merino and cross-breeds, and a small quantity of carpet wool is obtained from Sardinia. The bulk of the output is consumed locally.

(*k*) PORTUGAL

The most valuable Portuguese wool is the merino, which is similar to Spanish, which see. The other kinds are carpet wools and usually known as Oporto and Castel Branco.

(*l*) RUSSIA

In former days numerous varieties of wool were raised in Russia, and the supply was by far the largest in Europe. Special mention may be made of Odessa merino, which possessed good spinning properties and was exceedingly white, but even before the War the supply was falling off. " Donskoi " wool was the general name which covered all coarse wools from South Russia. The principal port of shipment was Rostov on the Don. It is coarse, but not kempy, and fibrous, white, straight, uniform and loose. Russian sheep were usually shorn twice a year, namely in the Spring and Autumn, and their wools were mainly used in the carpet trade. They had one particular advantage in that they were exceedingly suitable for forming an erect pile. In recent years, the competition of the other wool industries had raised the price quite 50 per cent., with the result that they were becoming too dear for most carpet manufacturers. Russian wool was generally washed in special washeries on the banks of the Don. The best wool of all came from Georgia, and there were two varieties, Toucha and Nouka, the former being the better, with a white springy strong staple. The Spring wool clip of this variety had a longer, finer and softer staple than the Autumn clip. The latter, however, gave a fuller thread with greater resisting pressure and was therefore more valuable for plush carpets. Both varieties were despatched from Tiflis in Caucasia. The whole output of Merino wool from the Don district was consumed by Russian and Polish mills. The bulk of the exports of various kinds of wool went to America. In 1905, out of 3,800 tons of this Don merino wool produce, 1,238 tons were sold to Russian mills. In European Russia the number of sheep was decreasing, for whereas in 1885 there were some 50,000,000, in 1906 there were not more than 43,000,000. The total merino clip of European and Caucasian Russia in 1885 was 37,000 tons, which had sunk by 1909 to 19,000 tons. The Kasan fleece wool is a lustrous slippery wool with a fine down undergrowth, but it is not such a good carpet wool as the Donskoi. Considerable numbers of sheep from South Russia of the Negretti merino variety have from time to time been moved to the steppes of Siberia, and, in particular, to the districts of Omsk and Petropavlovsk, and these flocks, at the outbreak of the War, supplied a considerable amount of the wool required by the Russian industry.

(*m*) SARDINIAN WOOL

This is a coarse variety which is used locally and is also exported to Italy and France, and used for mattress making.

(*n*) SCANDINAVIA

The wools of Norway and Sweden resemble Iceland wool, and for the most part are used locally.

(*o*) SPAIN

In 1908 there was a total of 16,119,000 head of sheep. One of the tragedies of industry is the decline of the quality of the wool produced in Spain. Formerly, this country was the home of the very best kind of merino. To-day she still produces a certain amount of merino, but it is a very inferior quality, and in 1919 was usually worth less than 9*d*. per lb. The other principal variety is known as Pyrennean. As its names implies, it is a mountain breed and produces a coarse, rough, carpet wool. Considerable quantities of wool are exported in an unwashed state to the French markets. The average annual export of raw wool in pre-war days was about 12,395 metric tons plus 1,360 tons of washed wool. During the same period the average importation was 90 tons of raw and 3,213 tons of washed wool, much of which came from Bradford in Yorkshire and from Roubaix in France.

(B) WOOLS FROM NON-BRITISH ASIA

For the most part the Asiatic sheep yield coarse wools only suitable for carpets and coarse cloths.

(*a*) ASIATIC TURKEY

From this country come various carpet wools of the best kinds ; Angora and Smyrna wools are generally exported unwashed and unclassified, which somewhat detracts from their value and decreases the amount the exporter obtains. If it were possible to grade them properly it would be more satisfactory alike to the buyer and to the seller. For the most part they are good long well-grown wools with a little coloured fibre mixed. The local Turkish carpet factories already absorb most of the supply. Smyrna is the centre of this manufacture, which is said to employ 70,000 people, with 45,000 hand looms scattered throughout Asia Minor. Syrian wools are usually washed and skirted, but contain over 10 per cent. of coloured fleeces. They are long combing wools and most suitable for the best carpet yarns.

(*b*) MESOPOTAMIA

Mesopotamia is of particular interest to British manufacturers now that it has passed under British control, and there seems reason for believing that with judicious crossing the breeds might be considerably improved, and at any rate the method of preparing, sorting and marketing could be brought more into line with those of more advanced countries.

The wools obtainable fall under three main headings :—

(1) Awassi.
(2) Karadi.
(3) Bussorah.

(1) Awassi wool comes chiefly from Mosul, a town between the Tigris and Euphrates near the Armenian borders. The wool contains a large proportion of coloured fleece. It is badly washed, and often the outside of a fleece is partly clean while the inside is untouched, the fleeces having been simply dipped in a stream of water and squeezed.

(2) Karadi wool comes from the Persian-Turkish frontier mountains and is coarser and longer than the preceding. Both are suitable for the manufacture of carpets.

(3) Bussorah wools have gained their name from the fact that they are packed in the City of Bussorah, but they actually come chiefly from the Persian border. They are tender, irregular and dirty, and are not even good carpet wools. They are sold principally in Liverpool. In addition, mention must be made of Baghdad wool. About half of this wool is brown, black or grey. It is used in making up blends and Kerseys or coarse Cheviot woollen cloths, also for carpets. It is superior to the Awassi and Karadi qualities, but like them is the product of the native sheep.

(*c*) AFGHANISTAN

The wool from this country is always exported in grease and unsorted and therefore it has a heavy shrinkage. It is, nevertheless, better than the Turkestan wools, to which it is somewhat similar. From the southern parts of Afghanistan the wool is sent into India, from the west into Persia, and from the north it used to go into Russia. There is an export tax of 2*d.* per lb. or £4 16*s.* per bale of 650 lb. on this material.

(*d*) CHINA

The number of sheep in China is in great dispute, but the fairest estimate is about 20,000,000 head. The wool varies widely in length, quality, colour and cleanness of staple, and it is used principally for American carpets. They are nearly always good spinning wools but lack springiness, and therefore the yarn is flat. The chief markets and ports of export are Shanghai and Tientsin, at which places the wool is usually sorted, graded and washed.

Kashgar wool, from Chinese Turkestan, is a valuable white, silky, soft wool which in normal times was generally exported to Russia for the manufacture of woollen cloth. The Mongolian wools are kempy. Those from the western part are best and were exported into Siberia where they were sorted and packed. From Central Mongolia the wool was collected at Urga, but it is inferior to the former kind. The wool from Eastern Mongolia is generally sold along with Manchurian. It is very coarse, but is usually washed before sale to save expense in transport. The bulk of the wool shipped from North China goes to the American market, and the total export in 1910 was 26,000,000 lb. against 45,000,000 lb. in 1909. It should be noted that considerable quantities of camels' hair are regularly exported from Tientsin. In 1910 the quantity was 3,000,000 lb. Goats' hair from Tientsin in 1912 amounted to 2,708,500 lb., while human hair is also regularly exported, and in 1911, 11,000 cwt. were despatched from Canton.

(*e*) PERSIA

A large amount of the Mesopotamian wool is really Persian ; nevertheless, a considerable quantity is also shipped direct from Persia. It is usually exported washed and sorted into white and coloured. Khorassan is the best type, and the Spring clip produces a good combing staple which is finer than a carpet wool. The coloured wool is used for coarse felts. The export fluctuates considerably; it has been as high as £300,000, but in 1910 it only amounted to £180,000. From Bundar Abbas two classes of wool are shipped: "Kurki," which in 1918 was worth about 6½*d.* per lb., and "Meherjun," which only fetched half the price. It was sold principally at Amritsar in India for the manufacture of carpets. Bushire wools come from South Persia and are similar to those from Bussorah, and are even dirtier than the latter.

(*f*) SIBERIA

The wool exported from Siberia includes some of that grown in Mongolia and is estimated at about 10,000 tons yearly. Much of it is short and coarse, but before the collapse of Russia the quality was tending to improve. The principal Wool Fairs were at Tiumen, and there were also wool commission agents in Petropavlovsk and Semipalatinsk. Tibetan wools have already been mentioned, under Indian, as practically the whole of the export goes to Calcutta.

(*g*) TURKESTAN AND CENTRAL ASIA

Bokhara wool is grey and black, with long staple, and it has a fine undergrowth in the Spring clip. Merv and Trans-Caspian wools are very similar, but usually have more white fibre in the staple. Calmet wools, which are obtained from the Kergiz sheep, are usually rough and coarse and full of kemps, the sheep having been badly handled and poorly nourished. The wool appears to be torn and not shorn from the sheep's back. It is only usable for the poorest class of carpets.

Practically this covers all sources of wool in Asia, and the only areas which at present appear suitable for further development outside British India are China and Mesopotamia, in both of which districts it is probable that if careful attention is given to the breeding and crossing of the native sheep with merinos, a good quality wool might be obtained within the next seven or eight years.

(C) NON-BRITISH AFRICA

The rest of Africa, which is not under British rule, does not produce much wool. On the whole, climatic conditions are against the sheep. The only suitable areas are :—

(*a*) Morocco.
(*b*) French Possessions in Tunis, Algiers, and also Tripoli.

(*a*) MOROCCO

By far the most important of the North African areas is Morocco. Washed wools are exported from Rabat and Saffi ; grease wools from Casablanca, Rabat, Laraiche, etc. Three-quarters of the whole quantity goes to France. A small quantity is made up by the native craftsmen into country made goods. In 1910 some 3,000 bales were shipped to England. For the most part, these wools are carpet wools. It is interesting to note that the Germans were taking considerable interest in Southern Morocco with a view to raising sheep there.

(*b*) TUNIS, ALGIERS, ETC.

The wools obtained from Tunis and Algiers are similar to those from Morocco and also to those from Tripoli. All of them are obtained from crosses of the coarse Guinea sheep with the merino, but the merino strain is now very slight. The wools are of little value and are used chiefly for felts, low-class blankets and rugs. A certain amount of export from Tunis goes to France and Italy. In 1909 the quantity exported was 1,400 tons, value £54,000. It is possible that more wool may be obtained from Tripoli now that it is settling down, but as yet little of real value has been obtained from that area.

(D) NON-BRITISH AMERICAN WOOLS

The United States in 1914 had 49,719,000 sheep and lambs. The bulk of these are grazed in flocks on open ranches, and the herding system involved necessitates high labour costs. The total wool clip of the United States for 1916 was stated by the National Association of Wool Manufacturers to be 288,490,000 lb. greasy, or 130,755,700 lb. scoured, and its value was estimated at 107,916,700 dollars. The chief wool-producing States were :—

States.	Sheep.	Wool producing.
Wyoming	5,500,000	36,000,000 lb.
Montana	5,500,000	36,600,000 ,,
Ohio	4,000,000	16,900,000 ,,
New Mexico	3,250,000	19,200,000 ,,
Idaho	3,000,000	19,000,000 ,,
Oregon	2,750,000	14,400,000 ,,
Michigan	2,225,000	11,500,000 ,,
California	2,250,000	13,300,000 ,,
Utah	1,750,000	14,200,000 ,,
Missouri	1,750,000	6,000,000 ,,
Texas	1,750,000	8,900,000 ,,
Colorado	1,500,000	1,900,800 ,,

The total percentages of the various types of sheep are as follows, throughout the United States of America :—

Merino and ¾ Bloods	52 per cent.
½ Bloods	17 ,,
Under ½ Bloods	31 ,,

The merino breeds are Rambouillet and American or Spanish. "Delaine" generally means the Ohio merino and the finer crosses. The "Delaine" wools of Ohio are considered the strongest merino wools in the world. There are also a number of good mutton breeds, including Cotswolds, Shropshires, Hampshires, Oxfords and Lincolns.

In speaking of American wools, the term "Territory" is usually applied to wool or sheep from west of the Mississippi River, while the term "Fleece" is applied to wools from the States east of the Mississippi. In the "Territory" there are estimated to be at least 30,000,000 sheep.

South American Sheep.

There are 67,000,000 sheep in the Argentine Republic and 26,000,000 in Uruguay, while sheep are also raised in Chile, Brazil and elsewhere.*

(*a*) ARGENTINA

This great South American Republic has been for many years one of the largest producers of mutton and wool in the world, but the tendency seems to be to reduce the number of sheep, or, at any rate, to increase the proportion of cattle against the number of sheep kept.

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* See *Wool Year Book*, but the Bulletin of Statistics issued by the Economic Council states that the Argentine had only 43 million before the War and 44,850,000 now.

Agriculture is also taking the place of sheep over large tracts of territory. In particular, the Italian immigrants are opening up large farms for the growth of grain. As the soil is perhaps the richest in the world and thousands of square miles exist which are free from stick, stone, hill or watercourse, tillage is easy.

Of the 67,000,000 sheep in the Argentine Republic 25 per cent. are merinos and fine crosses, and the remainder strong cross-breeds and mutton breeds. In quality the clip has been improving, and the introduction of long wool sires has led to the production of a larger quantity than formerly which is suitable for Bradford in contradistinction to French machinery. In 1850 the total output was only 17,636,800 lb. To-day the average export is 175,000 tons worth £12,000,000. The average size of flocks in the Argentine is 550, and they vary from 300 up to 3,000 or 4,000. Wool is exported from the River Plate and shipped to Antwerp, Dunkirk, Havre, Bremen, Hamburg and Genoa. The River Plate bale equals about 1,000 lb., and in 1918 an export duty was imposed on all wools exported from the Argentine.

(*b*) URUGUAY

Uruguay has a much warmer climate than Argentine, and is a more rocky and hilly country. It is therefore less suitable for agriculture or for large cross-bred sheep. Streams are abundant, and half the sheep in Uruguay are Rambouillets which have very dense fleeces. The total number of sheep in 1908 was 26,000,000, but in 1915 they had sunk to 12 to 15 million, and 80 per cent. of these are different kinds of merinos, the remainder being cross-breeds, Lincoln and Romney being the favourite crosses. The Downs, which were formerly tried, are no longer in favour owing to the fact that their fleeces are generally light. The tendency has been to use Lincolns and Romney rams, and as a result the wool has grown coarser. The practice has been to use cross-breed rams so as to keep 25 per cent. of merino blood which refines the wool and makes a good mutton sheep, and this custom is growing in popularity. The annual export averages 56,000 tons worth well over £4,000,000. The wool from Uruguay is generally known as "Montevideo," from the name of the capital, which is the port from which it is exported. An export duty is levied on this wool, as it is in the case of wool from Argentina.

(*c*) TIERRA DEL FUEGO

This island belongs partly to Chile and partly to Argentina, and is one of the best sheep countries in the whole world. It has a rich, black, peaty soil covered with clover and grasses, and abundant rainfall, with but little snow. On the Argentine side there are about 1,500,000 sheep, and the types are Romney, Lincoln, and crosses of these with Merino. The wools are good but coarse, and the wool from this island, as well as that from South Patagonia, is shipped from Puntas Arenas, and is known by that name. It is the bulkiest wool in the world and is very popular with the manufacturers of hosiery and goods of a spongy, springy nature. It is, in short, very similar to but a little finer than the wool obtained from the British Falkland Islands.

(*d*) OTHER SOUTH AMERICAN AREAS

From Valparaiso in Chile there comes a small quantity of carpet wool, and a similar wool is also grown in Cordoba, which is an interior province of Argentina. Between them, Chile and Peru export 28,000 bales of wool to Great Britain annually on the average, of which 75 per cent. is sold in Liverpool. Brazil is the only other country worthy of mention, and, according to official statistics, in 1912 10,653,000 sheep and 10,049,000 goats existed.* Briefly, then, according to Dalgety's *Annual* for 1912, South America possessed 109,693,142 sheep, and the production of wool from the same area in 1915 was estimated by the National Association of Wool Manufacturers of the United States of America at 477,413,707 lb. out of a total world's production of 2,836,519,000. The export of wool from the River Plate in 1916 was 344,000 bales; from Puntas Arenas, 62,000 bales; from the Falkland Islands, 8,500 bales.

* In 1916 there were 7,205,000.

Before closing this section we must point out that, particularly in the Argentine, the tendency is to go in more and more for breeding mutton sheep rather than high-class merinos, and this naturally leads to reduction in the total output of the best class of wool, which, coupled with the further tendency to develop cattle-raising and corn-growing in preference to sheep, will reduce the total supply of wool available for the European markets. In view of the fact that other districts in the world are also doing the same owing to the increasing demands of the meat trade, and above and beyond this economic factor when we have to consider the fact that the sheep population of Europe has been considerably decreased during the War, it will become evident that, as in cotton so in wool, there is a serious danger in the near future of an actual shortage of supplies, and in any case there is bound to be keen competition among manufacturers for what supply there is, resulting in high prices. Since cotton and wool are very often interchangeable, with the supply of both short, this fact will aggravate the situation as regards each separately.

CHAPTER VIII

THE VARIED USES OF WOOL, AND THE EFFECT OF FASHION AND OF THE WAR

THE manufacture of various types of woollen goods has shown for a long time a tendency to centre in certain districts in Great Britain. Thus Bradford is still the principal centre for worsteds and Huddersfield for high-class cloths. Leeds produces mainly clothing, while Halifax and Dundee are known for the production of their carpets. Rochdale produces chiefly Army and Navy flannels ; Witney is known the world over for its blankets. The West of England is the original home of broadcloths, while various parts of Scotland and Ireland have obtained fame as the centre of various homespuns and tweeds. In addition to these, mention must be made of Leicester and Nottingham, the great centres of the English hosiery trade. Leicester is, perhaps, the most important, and employs at least 30,000 persons in the trade if we include the yarn spinners, and there are a number of mills where more than 3,000 people are engaged. Various circumstances, such as having a convenient railway centre, have helped it to achieve its present importance, but perhaps the most important is the discovery of the secret of seamless hose. Nottingham is the real birthplace of hosiery, and it was there that Hargreaves and Arkwright went with their famous inventions, the spinning jenny and the water frame. Nottinghamshire was also the place where the stocking frame was invented. In Scotland, the principal hosiery centre is Hawick, but there is also a large production in Glasgow, while Dumfries has specialized in the knitted glove trade. Hand-knitted hosiery still flourishes in Ireland, particularly among the peasants of Donegal, and the

Scotch tweed industry centres round Galashiels, Selkirk and Peebles, the total consumption of wool being at least 30,000,000 lb. per year, and even before the present rise in the cost of all manufactured goods, the output was valued at over £12,000,000 annually. The West of England trade, famous in the Middle Ages, has tended to decline before the fierce competition of the Bradford worsteds. In Somersetshire, however, where worsteds have always been in use for the making of serges, the manufacturers soon adjusted themselves to new conditions, and Wellington is still the centre of a considerable production. In passing, it may be noted that it was at Wellington that the first khaki was made, and to this day knitting cloth for puttees is a speciality. Naval and military uniforms, liveries, and the scarlet coats worn by hunting men are still produced in Gloucestershire, and Wilton, in the West country, is still famous for its carpets. Witney, the home of the blanket industry, obtained that position early in the seventeenth century, but the blanket itself was made much earlier, and is said to derive its name from one Thomas Blanket, a Bristol weaver, who in 1320 produced a "fabric of wool with a well-raised nap." But even before that Witney must have been a producer of woollen goods, as we hear that Henry III spent £20 there on the purchase of articles for his wardrobe. In its total output of blankets Yorkshire has long surpassed Witney, but Witney blankets still, for the most part, obtain the highest prices.

Lancashire was, at one time, largely given over to the woollen industry, and even as late as the end of the eighteenth century it was her chief industry, but the advent of cotton seems to have led, with one notable exception, to the abandonment of woollens in favour of its new rival. The woollen industry then centred in Yorkshire, but Rochdale still remains one of the most important woollen centres, its speciality being the flannel from which the shirts of soldiers and the clothes of our sailors are made.

Nor must we omit to mention the woollen shoddy industry of Dewsbury and Batley. Perhaps, however, the most important centre of all, so far as the worsteds are concerned, is Bradford. At the beginning of the nineteenth century the population was about 5,000. To-day it is nearer 300,000, and besides doing the bulk of the home trade in wool, it dominates the London sales of imported wool. It has even been asserted that four-fifths of all woollen imports into England go to Bradford to be combed into tops or spun into yarn. Bradford is also the headquarters of the principal dyeing association and possesses the famous Bradford Technical College, which has a complete plant for the washing, carding, combing, spinning, weaving, dyeing and finishing of textiles, and has a staff of the ablest experts in the country. In particular, mention should be made of the strict regulations carried out in that town, and the system of certificates which act as a guarantee of the quality of its products.

A passing reference at least should be made to the invention of hosiery by a Nottinghamshire clergyman, the Rev. William Lee, curate of Claverton. By this invention a row of stitches could be made at once instead of one at a time. The date of it is 1589, and Queen Elizabeth accepted a pair of silk stockings from Lee, but appears to have done nothing for the inventor, who, in consequence, accepted the patronage of Henry of Navarre and died in France after the assassination of that king. Soon after his death his brother, James Lee, established the manufacture of hosiery in London, and in 1660 Charles II gave a monopoly to the London company. By 1695, 1,500 stocking frames had been set up in the metropolis, but from that date the industry tended to gravitate towards the Midland counties. By 1714, the number of frames in Nottingham were over 8,000, and by 1753 they had grown to 11,400, when the London company's monopoly was ended by Parliament. By 1800 there were 20,000 frames at Nottingham ; by 1844, 48,000. Other inventions and improvements followed, all tending to facilitate the production of hosiery. Both in Leicester and Nottingham a fair amount of cotton and silk, as well as wool, is used in the hosiery trade, and from being confined to stockings it is now being adopted for the making of gloves, shawls, jerseys, jackets, caps, mufflers, and underclothing of every description.

Hawick, Dumfries, Lanark and Glasgow are the chief centres for the hosiery trade in addition to Leicester and Nottingham.

Carpets are another woollen product which consume large quantities of wool. The wool used is of a different class from that needed for woollens and worsteds, being for the most part cheaper grade material; nevertheless, they are better than those used for the common felts, etc., and the bulk of the raw material comes from Asia. Notwithstanding, wool is also obtained from the sheep of Australia and New Zealand, and from the hardier breeds of our own country. To-day carpets are seldom made from wool throughout. They are mostly wool-faced, with backings of jute, flax or hemp, and the binding throughout is generally cotton. About seventy firms carry out the production and are chiefly found in the Midlands, North of England, and Scotland.

The uninitiated are sometimes misled by the names applied to various carpets; thus, Axminster is no longer made in the Devonshire town of that name. Indeed, it may almost be said that they are made anywhere except in that town whence they drew their name originally. Kidderminster now turns out few carpets of that name, the bulk coming from Scotland, whereas Kidderminster makes mostly Brussels, Wiltons and Axminsters. Nor do Brussels carpets come from Brussels, but chiefly from Halifax, Rochdale and Dundee. Although Wilton still produces excellent carpets, it by no means makes all those which are put on the market under that name. One of the principal buyers of British carpets is Canada, who takes about a quarter of our total exports.

The felt hat industry at one time consumed large quantities of wool, but to-day the best class bowler is made from rabbit fur, only the cheapest felts being made from woollen waste. The chief districts in which this trade is carried on are on the borders of Cheshire and Lancashire, the principal centres being Denton and Stockport.

Certain hair products are so closely associated with the woollen industry that they cannot be ignored. Thus, alpaca or llama is the wool obtained from the animal of that name, which lives on the Andes, at a height of 45,000 feet above the sea level. The hair is soft, pliable and elastic. It is usually dyed black. Mohair, which comes from the Angora goat, whose original home was in Asia Minor, can be dyed to any shade. The two main sources of mohair are Turkey and South Africa.

It is used for making dress materials for ladies' wear, and also for plushes, linings, braids and furnishing fabrics. Practically all mohair yarns, no matter where made up, are the product of England owing to the excellency of British spinning, with which the name of Sir Titus Salt, of Saltaire, near Bradford, is closely associated.

The wool industry has had its ups and downs like most of our British industries, and fashion—and in recent years, the War—have affected it in strange ways. Before the outbreak of the European War the worsted section was doing fairly well, but the outlook in the wool industry generally was by no means satisfactory. Even the worsted section had been threatened by the inroads made into the trade by the shoddy stuffs of Dewsbury and Batley, by the introduction of flannelette, and also, to some extent, by foreign competition. There was also a great falling-off in the demand for genuine woollen as distinct from the worsted articles. Indeed, at that time, almost the sole certain stand-by of the woollen industry appeared to be the Naval and Military Authorities. It was fashion which dealt this blow, but the change in fashion had sound reasons behind it. Towards the end of the nineteenth century athletics began to come into fashion among the rising part of the female population, and when girls began to play hockey and golf and to go into various kinds of sports heretofore regarded as the prerogative of the male sex, they were compelled to abandon the dress of their grandmothers as too bulky and full of restraints. The flannel petticoat was the first to go, and with it much of the thick, heavy clothing, and even girls who did not go in for athletics followed the new fashion and substituted close-fitting knitted hosiery for the old-fashioned woollens. At the same time, the substitution of flannelette for genuine flannel further reduced the demand for woollen goods. It must at the same time be admitted that much of the new hosiery is not made of wool but of cotton, or, at any rate, cotton mixed with wool. Nevertheless, the wool manufacturers by no means gave up the struggle, and in particular there was a greater demand for the better class cloths, of which special mention may be made of the homespuns, particularly the Irish and Scotch homespuns, and especially those from the Isle of

Harris. The War caused a sudden revival in the demand for woollens. Huge demands first of all for our own Armies and later for those of our Continental Allies revived the woollen industry and even strained it to its utmost, while, at the same time, there was no appreciable falling-off in the demand for worsteds. In pre-war times the requirements of the British Army and Navy hardly amounted to 1 per cent. of our total wool consumption, but within three months from the beginning of the War it jumped to 10 per cent. A civilian in this country normally consumes about 13 lb. of wool per year, and England has always been a heavy wool-consuming country, but a soldier's outfit requires some 32 lb. of wool, and the soldier needs more than one outfit per year. In normal years the total consumption of wool in the United Kingdom is at least 600,000,000 lb., and the total yardage produced is about 450,000,000 yards. In 1915 the total imports for consumption were 894,000,000 lb., and the total output 611,000,000 yards. The production of flannel alone for military purposes during the first eighteen months of the War was equal to two-and-a-half times the annual output for all purposes before the War, while that of blankets was at least five times the annual pre-war output. On the Continent, owing to the devastation wrought in the various industrial areas by the contending armies, their manufactures almost disappeared, and even now that Peace has been established it will be long before the wool industry can be re-established in many of its old Continental centres. Furthermore, during the War the civilian population, both abroad and at home, mostly went without, and practically the whole of the Continent is at present clamouring for cloth and woollen goods generally. These facts alone are bound to result in a big demand for British woollens, but if the supply of raw material had remained normal it need not have led to a considerable increase in the price thereof. Unfortunately, this is not the case. In addition to the general upset caused by the War there are at least two permanent factors tending to force up the price of wool. The first of these is a distinct decrease in the total world production of wool, and the second is the great increase in the civil consumption in all countries outside the Continent of Europe; particularly, however, this increase is noticeable in the United States, in Japan and China, and there is little doubt also that the larger wages of the labouring classes have led to a decided increase in the demand for cloths and other woollen goods in the United Kingdom itself. It is estimated that the total decrease in the world's production is at least 20 per cent. of the world's exportable wool, or equal to some 300,000,000 lb.; that is to say, the equivalent of the total pre-war import for consumption of the United States of America, Russia, Norway, Sweden, Denmark, Holland, Italy and Japan. One of the temporary causes of the decrease was the very heavy droughts experienced in Australia during 1915, which reduced the sheep flocks from 85,000,000 to 68,000,000; that is to say, a total loss of 17,000,000 sheep. Furthermore, in South America, wool production has been declining for many years owing to the competition of cattle-raising and wheat-growing.* In addition to this, we must add the wholesale slaughtering of sheep throughout Europe, which must decrease the wool production of the Continent to a very considerable extent and therefore add to the demand for overseas supplies. The countries which have suffered most severely are Germany, France (half her sheep), Belgium, Austria, Turkey, and most of the Balkan States. In addition to this, the chaotic state in which Russia now is eliminates her as a wool-producing country, and deprives the world of over 45 million sheep. The second factor is the greatly increased demand for wool products outside Europe. The principal areas where this is noticeable are America, China and Japan. In America the principal factor was an alteration in the tariff. For many years there had been a high import duty, namely 75 per cent. *ad valorem*, on all wools imported into America. In October, 1913, however, a period of free wool import was granted by the Simmons-Underwood Tariff Bill, and as the result, in the six months prior to the War the American imports of Colonial wool had increased threefold as compared with the similar six months of the preceding year. In 1915 her imports were, roughly, five times as much. Before the War the United States did not purchase more than 2,000 bales of South African wool, but in 1915–16 she took almost 200,000 bales. In 1916 the percentage of purchases was as follows :—

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* Uruguay alone holds barely half the sheep she did in 1908.

United Kingdom	from British Empire . .	58 per cent.
The Continent	,, ,, ,, . .	11 ,,
The United States of America	,, ,, ,, . .	31 ,,

The last figure should be compared with 1914 figures, when the United States bought only 6 per cent. from the British Empire. The decrease in the Continental demand, which is equal to 50 per cent. of the Colonial clips, had been fully compensated for by the War demands of the Allied armies, and therefore the increased demand from America and other countries, coupled with an actual decrease in the world's production, is steadily eating up the balance of wool carried over from previous years. These stocks are growing less and less, and the natural result is that the manufacturers of the world will compete more and more keenly against each other for future supplies of this essential raw material. Unless, therefore, a considerable increase in the immediate future is possible in the production of wool, the only alternative appears to be the discovery of some vegetable fibre other than cotton which can act as a partial substitute.

CHAPTER IX

POSSIBLE MEANS OF INCREASING THE SUPPLY OF WOOL

FROM the foregoing it will be fully realized that the shortage of wool with which the world is faced, coupled with a still more serious shortage in the supply of cotton, renders it a matter of prime importance, not only to the manufacturer but to everybody concerned, that adequate steps should be taken at once to increase the total output of this essential material. The situation in the cotton industry is more fully realized, perhaps, than it is in the wool industry, and efforts are already being made, and have for some years, in fact, been made, to endeavour to increase the world's supply of cotton, particularly the supplies available from within the British Empire. Similar steps are urgently necessary for wool if not only the United Kingdom, but the whole world is to be saved from considerable hardship.

There are many countries, and those generally the most important industrially, where a certain amount of woollen clothing is essential, and as the situation appears at present, there seems every likelihood that the poorer people in these countries will soon find it impossible to purchase woollen clothing at all.

Cotton clothing is by no means an entirely satisfactory substitute, but it is better than nothing. Yet the cotton industry is threatened with an even greater shortage of supplies. Under these circumstances, the far-sighted will naturally look round and see where a rapid increase of the wool supplies is most likely to be possible. Only after careful investigation, such as has been carried out for cotton by the Cotton Growers' Association, can we say for certain what new districts are most worthy of special attention, but the following areas are certainly deserving of careful study.

In India, by judicious crossing of the native sheep, great improvements can be effected in a very short time, and if it is possible, as appears to be the case, to produce by judicious crossing a finer quality of wool from the tens of thousands of sheep which are at present reared in the Northern Plains of India, a very considerable addition to the type of wool suitable for the English manufacturer would be obtained. When we recollect that the great flocks of Australia originated from the crossing of a few merinos with a handful of Bengal sheep, who, on their arrival, had hardly a scrap of wool, we shall see that this is by no means an impossible task. At the same time it is obvious that only certain districts are suitable, and it is just here that investigation is most desirable.

South Africa is already becoming an important contributor, but there seems no good reason why she should not produce still larger quantities of woolled sheep than she does at present. It is possible that certain areas in East Africa are also suitable if the native sheep are crossed with good merino rams.

Palestine and, to a certain extent, Mesopotamia could also carry an improved quality of sheep, and as all these areas are under British control, they are among those most deserving of immediate attention.

It has been shown that Canada could carry at least ten times as many sheep as she does at present without in any way disorganizing her agricultural output. Particularly is this the case with some of the Western States. Canada's total—under three million sheep—is perhaps one of the most astonishing agricultural facts of that great area. Nevertheless it is obvious that unless the price of wool is fairly high, Canadians would prefer to concentrate on the growing of wheat rather than trouble about the scientific raising of sheep on any considerable scale.

In the case of South Africa and Canada, the European population, with the advice of a few experts, are quite capable of increasing the number of woolled sheep if they could be convinced that it was desirable. In districts, however, where native sheep owned by the local inhabitants have to be improved, they would need the assistance and guidance of the Government or of some strong corporation. This would be essential, at any rate in the earlier periods.

This is particularly the case in India, Mesopotamia, Palestine and British East Africa. It would be no use for us to import a few rams of excellent breed and then leave the sheep who result from this crossing to degenerate again through lack of proper supervision. Proper stud farms would be necessary so as to keep, at any rate, a regular reserve stock of pure, or nearly pure, bred merinos. Considerable care would be required to acclimatize these to the new conditions under which they would have to live. An Association similar to the Cotton Growers' Association, or failing that, definite action on the part of the Departments of Agriculture, by the Governments concerned, appear to be the safest methods to adopt. Nevertheless the effort is well worth while.

It is greatly to be hoped that, coupled with improved methods of crossing and breeding, machinery will also be set up for the more scientific clipping, cleansing and baling of the produce. These latter points are particularly essential in a country like India, where the natives are apt to be careless and actually dishonest when baling their products. One of the chief reasons why Indian cotton fetches such comparatively low prices is the careless way in which it is handled after picking, the dirty condition in which it is received, and the watering of the bales so as to make them weigh heavier than they really are. In the same way, if good-class wool is being produced, it would be a thousand pities if the natives depreciated its value by mixing dirt and rubbish with it so as to make it weigh heavier when packed and baled.

These facts will show the seriousness of the situation, though there is no cause for panic, and the possible methods of ameliorating it, but if anything definite is to be done, action by some of the great wool associations seems to be the first step, and it is to be hoped that they will see their way to take the same active interest in the raw material of the wool industry that Lancashire has already done with cotton.

CHAPTER X

CONCLUSION—PRICES AND FURTHER STATISTICS

ENOUGH has been said to show that we are threatened with the possibility of a shortage of wool in the immediate future, and the list of prices given below are sufficient evidence if there were no other. During the War the Government obtained a monopoly of all the available wool supplies. This was needed so that they could be assured of the necessary supplies for the making of clothing for the Army. This is not the place to discuss the various questions arising from a recent report by the Committee of Inquiry into the wool trade, but any one interested therein can obtain a copy at H.M. Stationery Office.

Some further statistics indicating the different sources from whence we derive our supplies of wool and the amount we consume are attached hereto. Owing to the fact that it is so long since a census was taken of production, it is not possible to give any accurate figures of the actual number of looms and spindles employed. The fact, however, that the census of production will probably take place next year renders it desirable that every one interested in the wool industry should know what is available at the present moment, so far as the raw material is concerned, in order that when the figures of the census of production are to hand they will be able to add them hereto and thus obtain for the first time for fifteen years a really reliable picture of one of our greatest industries.

The mechanical improvements in the machinery employed and the production of various kinds of woollen products has been briefly touched upon in the foregoing pages, but more as illustrative of the condition of the industry than as an exhaustive treatise. This side of the subject lies outside our province, which is the wool supply of the world with special reference to the supplies obtainable within the British Empire. Nevertheless, it is only fair to put on record the fact that the

British manufacturer in wool, as in cotton, has only kept his pre-eminence in the markets of the world through his foresight, ability, integrity, and the promptitude with which he has been prepared to adopt improved methods of production. At the present moment the wool industry has before it the prospect of almost unlimited demands for its products, which means prosperity alike for employer and employee, and the only serious difficulty, barring labour controversies, is the possibility of a shortage of raw material. By himself, the manufacturer cannot remedy this shortage, but in co-operation with others, particularly far-sighted men who are prepared to develop the sheep industry and especially the production of wool on sound lines throughout the Empire, he can do much to relieve the situation. For shortage means high prices and these militate against a ready sale of our goods abroad.

In closing, we would emphasize the point that in the immediate future the difficulty will not be so much to obtain markets for our products—not only in wool and cotton but in almost every other line of industry—but to obtain adequate supplies of the necessary raw materials. All countries will have to face this problem, but few are better placed than Great Britain; for, within the British Empire, almost every important raw material can be obtained, and there are numerous sources of raw material which have hardly been developed at all yet. This factor, if fully realized, should enable us to re-establish our position as a great industrial and commercial country and render us independent, if necessary, of most other countries.

The bulk of the difficulties with which we are now faced could be solved along these lines, and in particular the adverse exchanges—especially those of America and some of the South American States—could soon be rectified if we were able to obtain food and raw materials in far larger quantities from within our Empire than we have hitherto attempted to do. For these reasons, although there are other areas outside the Empire which are suitable for producing an increased supply of wool, our efforts should be concentrated within the Empire, leaving other countries who are not so favourably placed the opportunity to develop these other sources and so keeping the bulk of our own products for our own consumption.

PRICES CURRENT, DECEMBER, 1916.

From the "Wool Year Book."

Description.	Extra.	Superior.	Average to Good.	Inferior to Average.
	s. d. s. d.	s. d. s. d.	s. d. s. d.	s. d. s. d.
Port Philip, scoured	4 11 to 5 3	4 1 to 4 10	3 3½ to 4 0	2 10½ to 3 2½
Do. greasy	—	—	1 11 ,, 2 6	1 7½ ,, 1 10
Sydney, scoured	—	4 0 ,, 4 9	3 2 ,, 3 10½	2 8½ ,, 3 1
Do. greasy	—	2 5½ ,, 2 8	1 10 ,, 2 5	1 6 ,, 1 9
Queensland, scoured	—	4 0 ,, 4 6½	3 3½ ,, 3 11	2 11 ,, 3 2½
Do. greasy	—	2 5½ ,, 2 9	1 10 ,, 2 5	1 7 ,, 1 9½
Adelaide, scoured	4 5	3 10 ,, 4 3½	3 1 ,, 3 9½	2 8 ,, 3 0
Do. greasy	—	—	1 9 ,, 2 2	1 5½ ,, 1 8½
New Zealand, scoured	—	3 11 ,, 4 3½	3 2½ ,, 3 10½	2 10 ,, 3 2
Do. greasy	—	—	1 10 ,, 2 4	1 7 ,, 1 9
Tasmania, greasy	—	—	1 11 ,, 2 5	1 7½ ,, 1 10
West Australia, greasy	—	—	1 10 ,, 2 3½	1 5½ ,, 1 9½
Cross-bred, Australasian, scoured	4 3 ,, 5 0	3 6 ,, 4 2	2 7 ,, 3 4	2 2 ,, 2 6
Do. do. fine greasy	—	—	1 11½ ,, 2 2½	1 7½ ,, 1 10½
Do. do. medium ,,	—	1 11½ ,, 2 1	1 9½ ,, 1 11	1 5½ ,, 1 9
Do. do. coarse ,,	—	1 11 ,, 1 11½	1 9½ ,, 1 10½	1 4½ ,, 1 8½
Do. N.Z., slipe	3 0½	2 9 ,, 2 11	2 3 ,, 2 8	1 11 ,, 2 2½
Do. do. fine greasy	2 6 ,, 2 7	2 3 ,, 2 5½	1 11½ ,, 2 2½	1 8½ ,, 1 10½
Do. do. medium ,,	—	1 11½ ,, 2 1	1 10 ,, 1 11	1 7½ ,, 1 9½
Do. do. coarse ,,	—	1 11 ,, 1 11½	1 10 ,, 1 10½	1 7 ,, 1 9
Lambs, Australian, greasy	—	—	1 3 ,, 1 10½	0 11 ,, 1 2
Pieces do. scoured	4 2 ,, 4 4	3 9 ,, 4 1½	3 0 ,, 3 8	2 2 ,, 2 11
Do. do. greasy	2 4	2 0½ ,, 2 3	1 7½ ,, 2 0	1 2 ,, 1 7
Cape, snow-white	3 10½ ,, 4 1½	3 4 ,, 3 10	2 7 ,, 3 3	2 2 ,, 2 6
Do. Western, greasy	2 3 ,, 2 4	1 11 ,, 2 2½	1 6 ,, 1 10	1 4 ,, 1 5½
Do. Eastern ,,	—	—	1 5 ,, 1 9	1 1 ,, 1 3
Do. Natal ,,	—	—	1 5½ ,, 1 9½	1 1½ ,, 1 4
Do. Short ,,	—	1 4½ ,, 1 7	1 1 ,, 1 0	0 11½ ,, 1 0½

WOOL PRICES.

	Lincoln Half-hogs (per lb.)	Colonial Tops (40's) (per lb.)
	s. d.	*s. d.*
31st December, 1913 . . .	1 0½	1 2½
,, 1914 . . .	1 2	1 6½
,, 1915 . . .	1 7	2 1½
,, 1916 . . .	1 10	2 9
,, 1917 . . .	1 6	2 10
,, 1918 . . .	1 7¼	3 1
,, 1919 . . .	2 3½	3 1
31st January, 1920 . . .	2 4½	2 11
14th February, 1920 . . .	2 3½	2 11

FURTHER STATISTICS

WOOL (RAW).

IMPORTS.

Statement showing the quantities of wool (of the sheep, lamb, alpaca, and llama tribe) imported into the United Kingdom from Australia, New Zealand, the Union of South Africa, British India, France, South America, and Turkey, the total imports from all British Possessions, the total imports and re-exports, and the quantities retained in the United Kingdom in each year from 1901 *onwards.*

Year.	Imports.									Re-Exports.	Quantities retained in the U.K.
	From Australia.	From New Zealand.	From Union of South Africa.	From Brit. India.	Total from all British Possessions.	From France.	From S. America.	From Turkey.	Total Imports.		
	million lb.	million lb.	million lb.	million lb.	million lb.	million lb.	million lb.	million lb.	million lb.	million lb.	million lb.
1901	334	140	71	24	573	17	68	12	692	294	398
1902	269	148	77	26	525	28	56	7	643	285	358
1903	223	155	78	32	492	16	62	10	605	285	319
1904	223	134	65	39	465	18	43	10	567	252	315
1905	254	139	68	39	504	20	53	12	620	278	342
1906	253	147	67	46	518	21	58	12	645	267	378
1907	322	158	92	46	622	24	74	9	764	313	451
1908	321	160	81	34	600	17	79	6	724	326	398
1909	313	176	116	56	666	27	77	10	809	391	418
1910	315	190	104	53	668	28	70	10	803	335	468
1911	324	174	102	57	660	23	85	12	800	305	495
1912	285	184	121	55	651	30	93	8	810	338	472
1913	265	181	133	55	642	25	100	9	806	307	499
1914	239	185	122	47	597	19	73	4	717	296	421

NOTE.—Wool is imported in smaller quantities from Egypt, the Falkland Islands, Belgium, China, Germany, Russia, and the United States of America.

WOOL (RAW).

Production and Consumption.

Statement showing the estimated quantities of wool produced in the United Kingdom, the exports of British and Irish wool, and the quantities of wool retained for consumption in each year from 1901 *onwards.*

Year.	British and Irish Wool.		Quantities retained for Consumption.	Imported Wool retained for Consumption.	Estimated Consumption in the United Kingdom.	
	Estimated Clip.*	Exports.			Total.	Per Head of Population.
	million lb.	million lb.	million lb.	million lb.	million lb.	lb.
1901	138	20	118	398	516	12·4
1902	136	37	99	358	457	10·9
1903	133	36	97	319	416	9·8
1904	132	38	94	315	409	9·6
1905	131	35	96	342	438	10·2
1906	130	30	100	378	478	11·0
1907	131	31	100	451	551	12·6
1908	134	38	96	398	494	11·2
1909	142	62	80	418	498	11·2
1910	143	37	106	468	574	12·8
1911	136	31	105	495	600	13·2
1912	133	47	86	472	558	12·2
1913	125	29	96	499	595	13·0
1914	121	38	83	421	504	10·9

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* Estimates of domestic clip (fleece washed) as given by Messrs. Helmuth, Schwartze & Co in their Annual Wool Reports.

MOHAIR.

IMPORTS, ETC.

Statement showing the quantities of mohair (Angora goats' hair) imported into the United Kingdom from the Union of South Africa and Turkey (European and Asiatic), the total imports from all British Possessions, the total imports and re-exports, and the quantities retained in the United Kingdom, in each year from 1901 *onwards.*

Year.	Imports.				Re-Exports.	Quantities retained in the United Kingdom.
	From the Union of South Africa.	Total from all Brit. Possess.	From Turkey (European and Asiatic).	Total Imports.		
	million lb.	million lb.	million lb.	million lb.	million lb.	million lb.
1901	10·6	10·7	9·1	19·9	0·6	19·3
1902	18·2	18·2	11·5	30·0	1·6	28·4
1903	15·8	15·8	12·1	28·0	2·6	25·4
1904	14·0	14·0	10·8	25·6	2·7	22·9
1905	12·5	12·5	12·5	25·3	1·3	24·0
1906	15·6	15·6	10·6	27·4	1·4	26·0
1907	19·1	19·1	11·7	31·3	0·7	30·6
1908	17·8	17·8	7·5	25·4	0·8	24·6
1909	19·4	19·5	10·8	30·3	0·8	29·5
1910	18·5	18·5	11·3	30·0	1·0	29·0
1911	18·7	18·8	6·5	25·5	0·6	24·9
1912	24·4	24·5	10·5	35·7	1·0	34·7
1913	18·5	18·6	10·4	29·3	1·5	27·8
1914	17·6	17·6	9·0	26·8	1·2	25·6

NOTE.—Consignments of mohair are also recorded in earlier years from British India and recently from China and France.

WOOLLEN RAGS (INCLUDING SHODDY).

IMPORTS AND EXPORTS.

Statement showing the quantities of woollen rags imported into the United Kingdom from France, Germany, and the United States of America, the total imports from all British Possessions, the total imports and exports, and the excess of imports in each year from 1901 *onwards.*

Year.	Imports.					Exports.			Excess of Imports.
	Total from all British Possess.	From France.	From Germany.	From the U.S.A.	Total Imports.	British and Irish Produce.	Foreign and Colonial Produce.	Total Exports.	
	thousand tons.	thousand tons.	thousand tons.	thousand tons.	thousand tons.	thousand tons.	thousand tons.	thousand tons.	thousand tons.
1901	1	9	8	0	30	*	0	†	†
1902	1	10	8	0	33	*	0	†	†
1903	1	11	7	0	32	*	0	†	†
1904	1	16	8	0	41	3	1	4	37
1905	1	14	10	0	41	6	5	11	30
1906	2	14	16	0	44	7	4	11	33
1907	2	17	16	2	51	6	7	13	38
1908	2	9	12	4	40	4	2	6	34
1909	2	12	11	9	48	4	3	7	41
1910	3	15	12	18	62	8	7	15	47
1911	2	12	11	20	59	8	5	13	46
1912	2	8	15	13	51	9	0	9	42
1913	3	11	15	11	54	10	1	11	43
1914	2	9	7	10	43	8	0	8	35

* Not separately recorded. † Complete figures not available.

NOTE.—The exports from the United Kingdom (British produce) consists mainly of pulled rags (shoddy or mungo), whilst the imports are mainly "not pulled."

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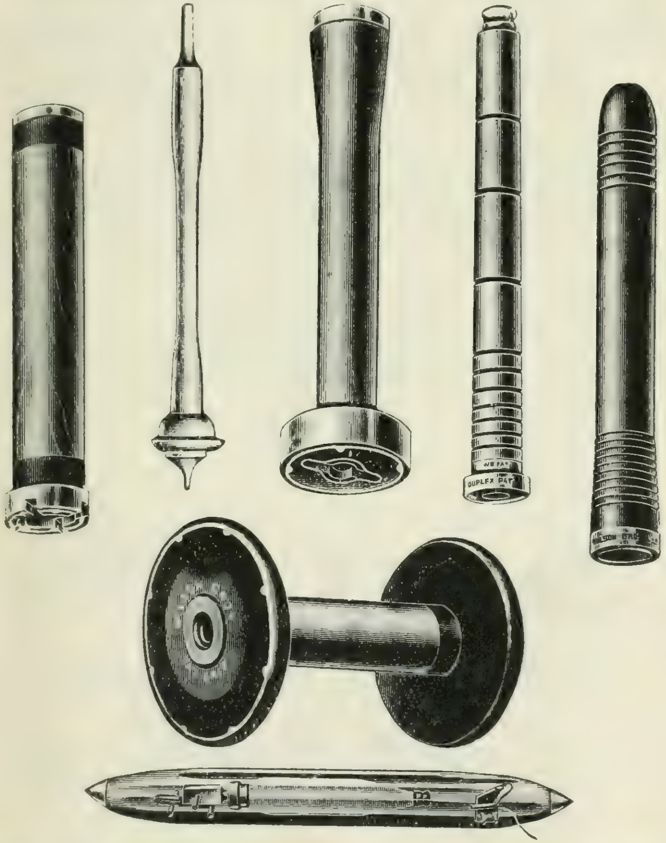

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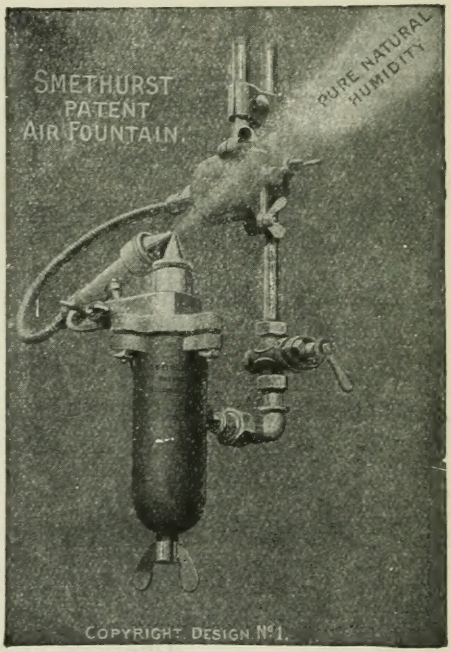

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